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PROPOSED NEW LIGHTHOUSE AT THE MOUTH OF THE WESER.

FIG. 1 represents a longitudinal section of a metallic caisson having in plan the form of an ellipse of 13·5 meters in the direction of its longer axis, and of 10·5 meters in that of its shorter, and which was to have been sunk in open sea to serve as a foundation for the tower of a lighthouse at the mouth of the Weser.

This caisson was to have been sunk to a depth of 22 meters below the level of low water; but when it had reached a point within one meter of its final destination, it disappeared during a tempest as if it had been suddenly buried under the earth. As a result of the searches made to ascertain the exact cause of the accident, it was found that the caisson had broken at about two meters above the sea bottom, carrying along in its fall the engines, windlasses, and all other objects placed on the scaffolding that surrounded it.

It is to be presumed that the cause of the accident was due to a sudden influx of the waves into the interior of the caisson; and the cross-stays that strengthened the iron framework having been broken by the onset, the sides were not strong enough to resist the pressure of the water and were carried away.

The consequence of this accident was the loss of all the work already executed, for not only was it impossible to utilize what remained, but it was even necessary to remove the part buried in the earth. This caisson had been constructed at Bremen during the winter of 1880–81, and had been provided with a tight roof and then ballasted with beton so that it might float. It was finally towed to the spot where it was to be sunk. The bottom at this place consists of sand mixed with stones and debris of shells, and the depth of the water is 17 meters. The project consisted, as shown by Figs. 2 to 5, in building above the foundation a tower having the form of a truncated cone. This foundation consisted of a mass of beton and masonry surrounded by a metallic sheath. At the base of the caisson there was a work chamber 2·5 meters in height, having a ceiling, and being divided into several compartments by beams that served to give the structure very great strength. The air-well, with its air-lock, was situated in the center of the caisson. The beton with which this latter was filled in order to make it sink, did not rest directly upon the roofing of the work chamber, but upon old rails laid thereon, so as to form a continuous course. The caisson, once put in place, was sunk by allowing water to enter it. This water was afterward expelled by means of compressed air. The beton was manufactured with the sand taken out in the work chamber. The caisson was cross-braced internally by stays, and carried, at 14 meters above the lower edges, a flooring upon which were set up the boilers, engines, air compressors, air-lock, windlasses for maneuvering the anchorage chains, and the pumps for lifting the water that entered the caisson. It was in this state (Figs. 6 and 7) that the caisson was floated from Bremen to the spot where it was to be sunk. The towing of this enormous mass was performed without any great difficulty. Its immersion was effected with the greatest regularity, it having previously been fixed in a definite position by the aid of four anchors let down at some distance away. The accident which has just destroyed the excellent results that had been obtained up to the time is due, as has been observed above, to the fact that the height of the sides above the level of the water being insufficient, the water was enabled to introduce itself into the interior of the work, break the stays, and tear the metal.—*Annales des Travaux Publics.*

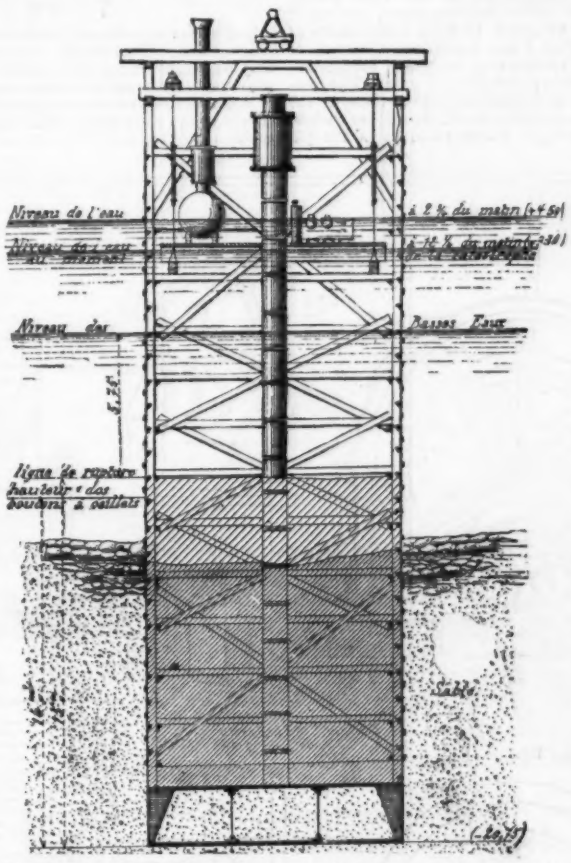


Fig. 1.—Longitudinal View of the Caisson, showing the state of the work in November, 1881.

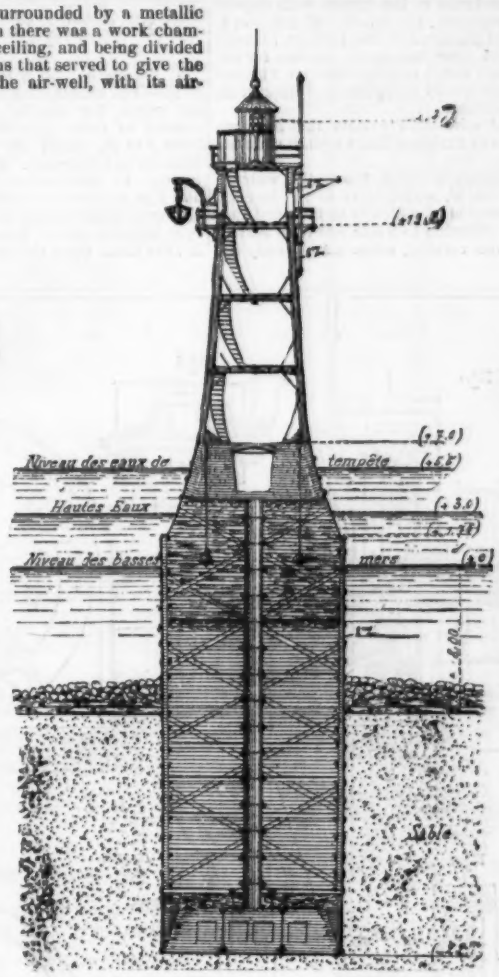


Fig 2.—Longitudinal View of the Tower and its Foundations.

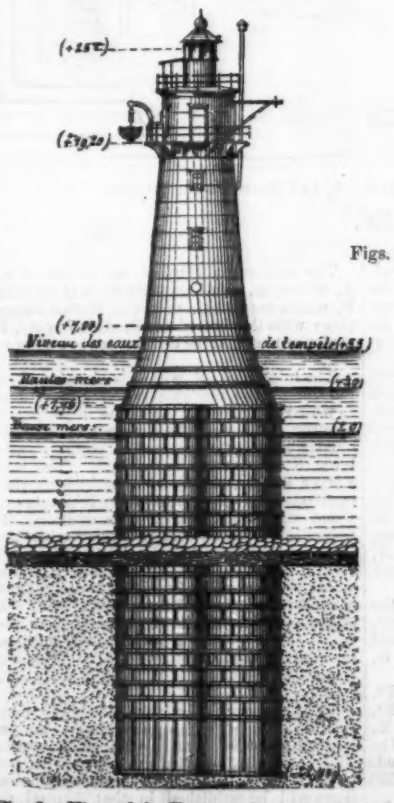
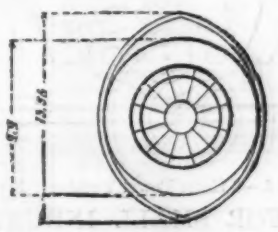
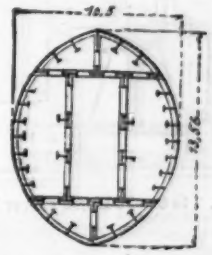
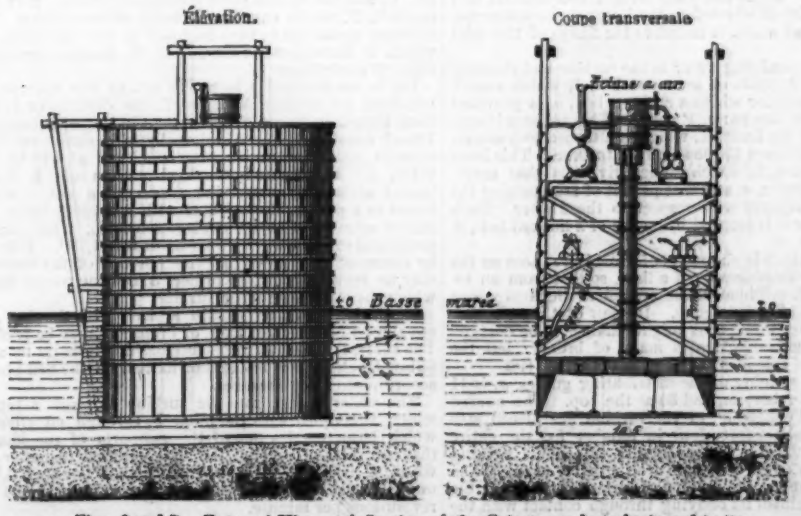


Fig. 3.—View of the Tower as it was to appear when finished.





Figs. 4 and 5.—Plan of the Tower and Horizontal Section at the level of the Caisson Work Chamber.



Figs. 6 and 7.—External View and Section of the Caisson ready to be towed to its destination.

PROPOSED NEW LIGHTHOUSE AT THE MOUTH OF THE WESER RIVER.

THE correspondent at Rome of a German paper writes that the project of a tunnel under the sea between Calabria and Sicily is making rapid progress. The Venetian Railway Co. has finished its surveys, and the plans submitted to the Minister. The length of the tunnel is 8½ miles, estimated cost, £2,840,000, including £220,000 for the junction of the tunnel with the Messina station.

TURBINES FOR SMALL INDUSTRIES.

MESSRS. TH. BELL & CO. are manufacturing at their extensive works at Kriens, Switzerland, a line of small turbines, designed more especially as motors for small manufacturing industries, and three types of which we illustrate in the accompanying plate.

1. *Turbine capable of furnishing a power of thirty horses* (Figs. 1 to 3).—This motor is shown in longitudinal section in Fig. 1, and in transverse section in Fig. 2. It consists of a wheel, A, with buckets, a^1, mounted upon a horizontal shaft, B, which likewise carries the wide pulley, C, over which the driving belt passes. The shaft revolves in two pillow blocks, D and D^1, one of which is mounted upon a cast iron standard, E, and the other upon the conduit, F, which leads the water to the movable wheel. These different parts have for base a bedplate, G, which carries a casing that fits exactly around the turbine.

This system of partial admission is essentially adapted for high heads and small discharges of water; for, notwithstanding the large circumference of the turbine with respect to that of the eduction apertures, the velocity of rotation is still very great. Were the diameter of the turbine reduced so as to allow of admission over the entire surface for the same volume of water, such speed might attain an unusual figure, and the turbine itself would be reduced to dimensions that were entirely impracticable.

It is, in fact, the partial admission system that has been adopted in the three types of turbines that we shall examine in the present article.

Here the conduit, F^1, through which the motive water is led, is coupled with the pipe, F, which runs to the interior of the wheel, A, and the section of which is so modified that it tapers in a longitudinal direction to a size less than that of the internal diameter of the turbine, while transversely the charge may reach as much as 50 liters per second. In fact, a head of 80 meters corresponds to a velocity of discharge of $V = \sqrt{19{\cdot}63 \times 80} = 39{\cdot}61$ m.

The five distributing orifices represent together a section of 0·00033 of a square meter × 5 = 0·00165 of a square meter. It follows that the total discharge, with a coefficient of performance of 80 per cent., will rise to

0·00165 square meter × 39·61 m. × 0·8 = 0·052385 cubic meter.

The corresponding power equals 52·3 l. × 80 m. = 4178 kilogrammeters, say 56 horses, or an effective power of 28 to 30 horses.

As for velocity, the manufacturers appear to have admitted an average one-third that of the inflowing water. Under these circumstances, and the internal diameter of the turbine being equal to 0·7 of a meter, we shall find the velocity of rotation in the following way:

We have velocity V = 39·61 m. . . . . $v = 13{\cdot}2$ m.; internal circumference = 2·199 m. Whence, for the velocity of rotation:

$$N = \frac{13{\cdot}2 \text{ m.} \times 60''}{2\ 199 \text{ m.}} = 360 \text{ revolutions per minute.}$$

2. *Turbine capable of furnishing a power of 3 horses* (Figs. 3 to 6).—The manufacturers build after this model two different types, the smaller (represented in the cuts) giving powers of from ½ to 3 horses, and the larger, powers of from 3 to 10. Both are arranged to work under heads of from 56 to 120 meters. Figs. 4 and 5 represent this style of turbine in longitudinal section and horizontal projection, and Fig. 6 gives the details of buckets and gate. The general arrangements are in all respects similar to those of the type just described. The movable wheel, A, and its spokes, A', are fixed upon the shaft, B, which revolves in the pillow-blocks, D and D'—the first being fixed upon the standard, E, and the second upon a support forming part of the conduit, F, which carries the water to the turbine. These different pieces are in turn fastened to the bed-plate, G, on which is likewise fixed the casing, H, through the intermedium of angle irons.

But in the particular instances where the volume to be admitted or discharged is small, the distributer is much more simple in its arrangement than in the preceding model. Thus it consists (I, Fig. 6) internally of a simple cavity and a single orifice, *a*, which may be closed at will by a slide valve, J. This latter is provided with a rod, *b*, having a thread at its upper part and traversing a nut, *c*, which is keyed to a pinion, K, provided with helicoidal teeth. This pinion engages with an endless screw, L, whose axis, M, prolonged externally, carries a hand wheel, M^1. It is, then, by means of this latter that the position of the register, J, may be regulated and the orifice, *a*, be uncovered, through which the water enters the turbine.

Here the spokes are cast in a piece with the rim, A, the metal used being either iron or bronze as may be preferred. The shaft, B, requires to be supported externally by a third pillow-block, either isolated or located on the bed-plate, G, according to circumstances.

The water is led into the turbine through a pipe, F^2, which is coupled with the inlet, F, through an elbow, F^1, which latter carries one of the supports of the shaft, M, that controls the register, J. The external diameter of the wheel, A, is 0·57 m. It is provided with 50 buckets, A^1, and, under a head of 100 meters, its rotary velocity is 500 to 550 revolutions per minute.

The strongest turbine built after this model, and giving a power of from 3 to 10 horses, has a diameter of 0·750 m., and is provided with 70 buckets.

The following figures give the discharge of water in this small model, and the velocity that is claimed for it.

The velocity of the escape corresponding to 100 meters, equals—

$$V = \sqrt{19{\cdot}62 \times 100} = 44{\cdot}29 \text{ m.}$$

With this velocity, and with an inlet orifice of 125 square millimeters, the discharge will reach—

0·000125 sq. meter × 44·29 m. × 0·8 = 0·004429 cubic meter.

The corresponding power will equal—

$$\frac{4{\cdot}429 \text{ k.} \times 100 \text{ m.}}{75} = 5{\cdot}9 \text{ H. P.}$$

or an effective power of about 3 horses.

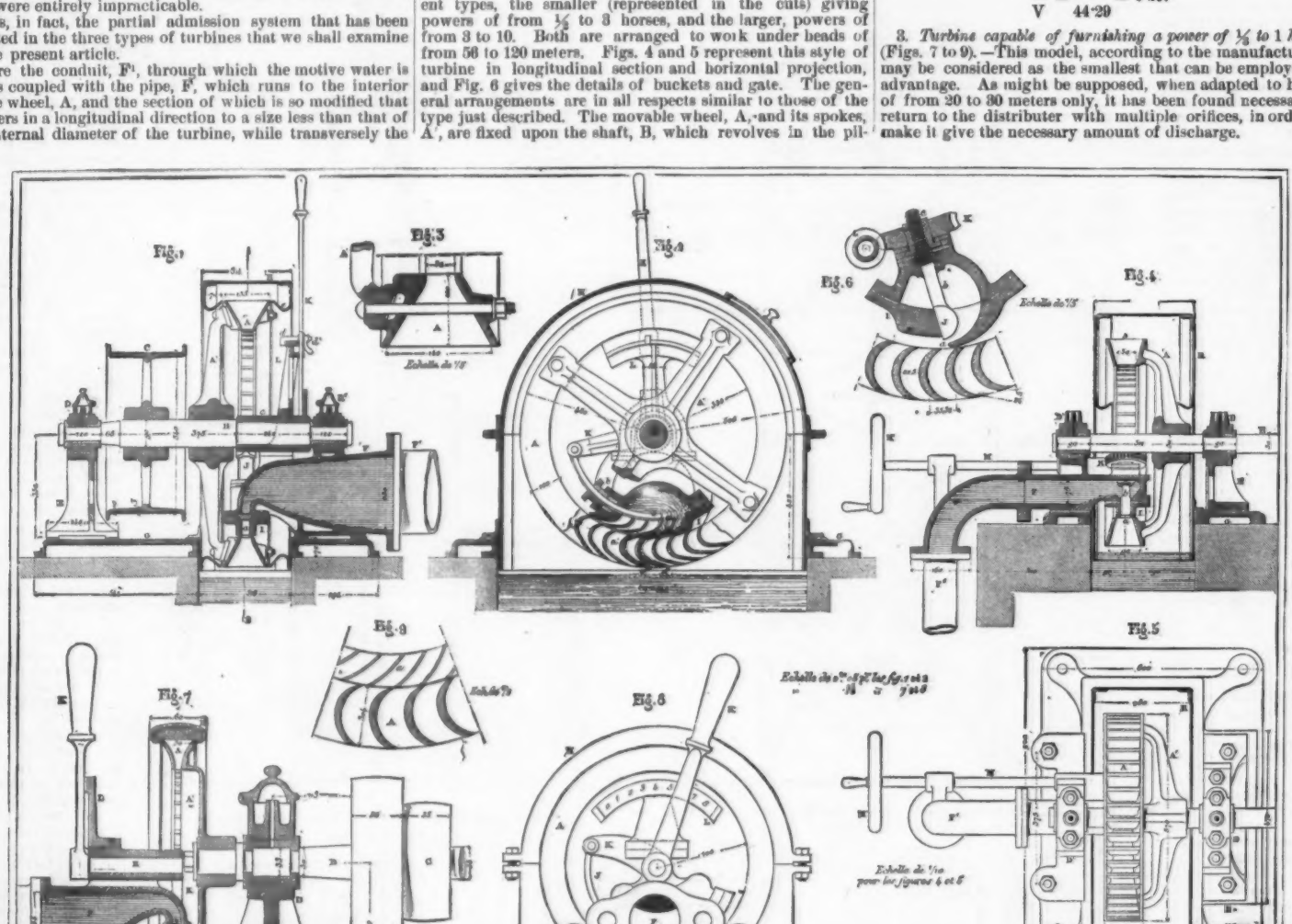
Now, with a velocity of 550 revolutions per minute, the circumferential velocity of the interior of a wheel whose internal diameter is 0·42 m., and whose circumference is 1·32 m., will be equal to—

$$v = \frac{1{\cdot}32 \text{ m.} \times 550 \text{ t.}}{60''} = 12{\cdot}10 \text{ m.}$$

It results from this, then, that the ratio between such velocity and that of inflowing water is—

$$\frac{v}{V} = \frac{12{\cdot}10}{44{\cdot}29} = 0{\cdot}29.$$

3. *Turbine capable of furnishing a power of ½ to 1 horse.* (Figs. 7 to 9).—This model, according to the manufacturers, may be considered as the smallest that can be employed to advantage. As might be supposed, when adapted to heads of from 20 to 30 meters only, it has been found necessary to return to the distributer with multiple orifices, in order to make it give the necessary amount of discharge.



Figs. 1 to 3.—30 Horse Power Turbine. Figs. 4 to 6.—3 Horse Power Turbine. Figs. 7 to 9.—¾ to 1 Horse Power Turbine.

TURBINES FOR SMALL INDUSTRIES.

said section is sufficiently wide to embrace the five distributing apertures, *a*. These latter are formed in a circular cast iron piece, I, which is adapted to the internal circumference of the turbine, and which is bolted to the flange of the inlet pipe, F.

The device for admitting water to the turbine and shutting it off therefrom, consists of a curved bar, J, which constitutes a register, and for which a stuffing box, *b*, is provided at the junction of the parts, F and I. This register is operated by means of the lever, K, which is attached to a sleeve, *c*, revolving freely upon the shaft of the turbine. This lever moves over a sector, L, which carries divisions that correspond to the apertures, *a*, and that permit of ascertaining the position of the register with respect to these latter. Each position of the lever is secured by means of a hooked bolt, *d*, and its finger nut, d^1.

The turbine, which is shaped conformably to those on the Girard plan, has considerable of a flare, so that from an internal width of 40 millimeters the system of buckets opens out externally to 140 millimeters. In view of the wear that would result from water that might chance to be charged with sand, the movable rim is made of bronze; but the spokes, A^1, are of cast iron, and are bolted to the rim.

The minimum spacing of the distributing guides, *a*, is 11 millimeters at the bottom, and 30 at the top. The curved float boards, or buckets, a^1, of the turbine, are placed still further apart, and are forty-four in number for the entire circumference. As for the casing, H, this offers nothing worthy of note except the plate iron caps, *e*, which are so arranged as to confine the volume of water surrounding the wheel and to diminish its eddying through contact with the external air.

This little motor is applicable for heads of water varying from about 40 to 80 meters; and, with the latter, the distributer is much more simple in its arrangement than in the preceding model. Thus it consists (I, Fig. 6) internally of a simple cavity and a single orifice, *a*, which may be closed at will by a slide valve, J. This latter is provided with a rod, *b*, having a thread at its upper part and traversing a nut, *c*, which is keyed to a pinion, K, provided with helicoidal teeth. This pinion engages with an endless screw, L, whose axis, M, prolonged externally, carries a hand wheel, M^1. It is, then, by means of this latter that the position of the register, J, may be regulated and the orifice, *a*, be uncovered, through which the water enters the turbine.

The apparatus consists, as before, of a movable wheel, A, of bronze, cast in a piece with the spokes, A^1. The axle, B, which is of steel, revolves in two supports, D, cast in a piece with the bed plate, G, which latter, for this reason, is prolonged beyond the driving cone so as to receive the second support.

The inlet pipe, F, which is likewise of bronze, enters the interior of the movable wheel and terminates in a sector, I, which is traversed by nine injecting orifices, *a*. The opening of these latter is regulated, as in the first example cited above, by means of a sector, J, attached to a bent lever, K, fixed upon an axle, E. The latter terminates in a lever handle, K^1, by means of which the register is maneuvered. As before, the lever, K^1, rests on a sector, L, provided with the necessary graduation. The shaft, E, revolves in a bushing cast in a piece with the conduit, F. The structure of this little motor is further distinguished by the casing, H, which is of bronze, and a transverse section of which is seen in Fig. 7. The internal diameter of the turbine is 200 millimeters, and the external 260. The internal width of the movable rim is 6 millimeters, while externally the width of the system of buckets is 30 millimeters.—*Machines, Outils et Appareils.*

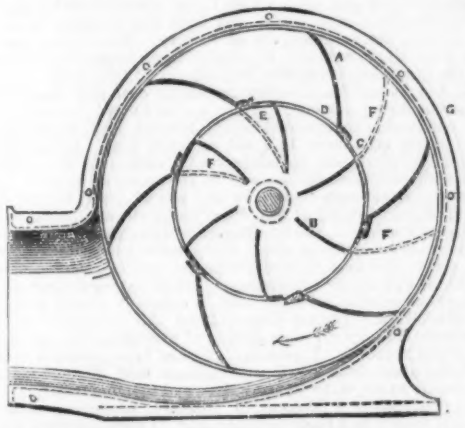
THE *American Architect* has been conducting a competition among young architects for a design for a "dwelling-house whose cost shall approximate $3,000." This competition closed on January 23, and is said to have resulted most satisfactorily. A large number of the designs will be published in that journal during the year, with full specifications, thus affording the public an opportunity of ascertaining what can be accomplished in house-building for a small amount of money.

A NEW FAN.

THE literature of fans is extremely meager; so meager, indeed, that it may be said that little or nothing useful has been written concerning them. It is known, however, that in practice fans cannot give high pressures or powerful exhausts, and that both pressures and exhausts are comparatively insignificant, unless a very high velocity is imparted to the vanes or blades. Some interesting experiments were carried out in connection with the sack drying experiments at Reading last summer. It will be found that the highest water column supported was 5·5 inches, the velocity of the tips of the blades being 9,233 feet per minute. The fan was of the common type and 2 feet 11 inches in diameter. The suctions were plugged up, so that the fan had full power over the exhaust tube to the water gauge. This was by no means a bad performance, and was quite as good as the majority of fans can show. Indeed, there is every reason to think that the efficiency of fans as regards the pressures and exhausts they can produce are but little effected by modifications in the shape of the blades or the curves imparted to them. That there are some proportions better than others Mr. Buckle has shown, and we have given these proportions on page 171 of our last volume. But it does not appear that these modifications of form do much toward augmenting the pressure and exhaust of a fan, but rather that they tend to make it run silently, and give a higher efficiency per horse-power expended in driving the fan than it would give without them.

In order to get higher pressures with foundry fans, backing two fans on each other has been tried. In this case the first fan delivered air under a pressure of 3 inches or 4 inches of water into the second fan, which further augmented the pressure; but it does not appear that any success has attended these experiments; at least, very few, if any, fans of the type are now in use.

We illustrate here a fan which gives results so remarkable that they tend to prove that all the theories hitherto held concerning the action of fans must be modified. Indeed, it is perhaps hardly too much to say that this fan is more powerful than any other fan which has yet been made. We have carried out some experiments with a model fan only 6 in. in diameter and 3 in. wide, which gave results quite unparalleled by any fan of the size with the construction and working of which we are acquainted. With a velocity of 4,200 revolutions per minute it supported on the exhaust side a column of water over 7 in. high, the exhaust tube end passing through a hole in a piece of board placed over the central orifice, which is 3 in. diameter. A 14 in. fan,



worked by hand and making 2,100 revolutions per minute, supports a column of 8 in. The velocity of the tips of the blades is 7,700 ft. per minute. The largest fan at Reading carried, as we have said, but 5·5 in. of water with a blade speed of 9,233 ft., so that the Capel fan is, roughly speaking, twice as powerful. Further experiments will be tried, and more information obtained, but as the matter now stands it appears to be clear that the Capel fan deserves careful consideration.

It is not easy to see why it should be so powerful. If we had not convinced ourselves by direct experiment of the capabilities of the fan, we should not have hesitated to condemn its design. It will be seen that it consists of two sets of blades, an outer set, A, and an inner set, B. There is nothing remarkable about the curves of these blades, nor does it appear that any particular curve must be accurately followed. The outer blades are fixed on a drum, C, and in this drum are cut ports or openings, D. The sheet iron is cut along three sides, and bent along the fourth, so that the inner blades, B consist of the sheet iron removed to make the ports, D. Nothing can be simpler. The inventor—the Rev. G. Capel, of Passenham, near Stoney Stratford—has carried out many experiments with fans. It would appear at first sight that the drum, C, is a positive evil, hindering the escape of air. Accordingly he constructed a fan similar in all respects to that which we tried, with the difference that the drum was suppressed, and the blades were carried inward, as shown by the dotted lines at E E. The result was that the fan could only be got to lift about 2 in. of water instead of 7 in. Then a fan was tried with the blades, B, extending outward as shown by the dotted lines, F F. The result was, if possible, worse.

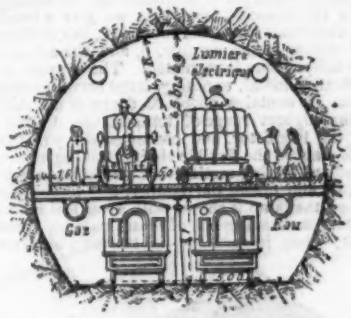
It would seem, therefore, that the entire value of the fan resides in the remaining portion of the drum, C. With the greater portion of the outer case removed, the fan will still lift 2 in. of water; and it is a noteworthy fact that if an anemometer be held to the fan when the casing is removed, at about the point, G, double currents will be found to exist. If the anemometer be moved toward the suction side of the fan—it only inhales at one side—the wheel will revolve briskly, showing a strong outward current thrown off by the fan blades. If, now, the anemometer be moved toward the opposite side of the case, still at the same level, it will be found that there is strong *indraught* at the circumference of the fan.

We do not at present attempt to account for the efficiency of this fan. Possibly some of our readers may like to make the attempt; we prefer to await the issue of further experiments. We shall only add here that suctions as great have been obtained with other fans; but never with anything like the same small velocity of blade tip. It is in this that the efficiency of the Capel fan consists. No dynamometer experiments have yet been made, and we are therefore not in a position to speak as to the actual efficiency of the fan in terms of the weight of air moved at a given velocity in a given time per horse-power expended; but there is every reason to think that this efficiency will be very high. We give particular prominence to the invention because of the singularity of the results obtained.

Mr. Capel first turned his attention last year to fans for stack drying, and he has devised several simple and ingenious arrangements of his fan for the use of farmers. In conclusion, we may say that no fan was tested at Reading which at all approached this in efficiency as regards power of pulling air through a stack or hay rick—*The Engineer*.

PROJECT OF A TUNNEL UNDER THE ELBA, NEAR HAMBURG.

IT has recently been proposed to establish a direct communication between the port and the city of Hamburg by means of a tunnel having a width of 9 meters and a height of 7·5. The accompanying figure represents a transverse section of the projected work, which will include two roadways—one below for the passage of a tramway, and one above for carriages and pedestrians. This latter will be lighted by gas.



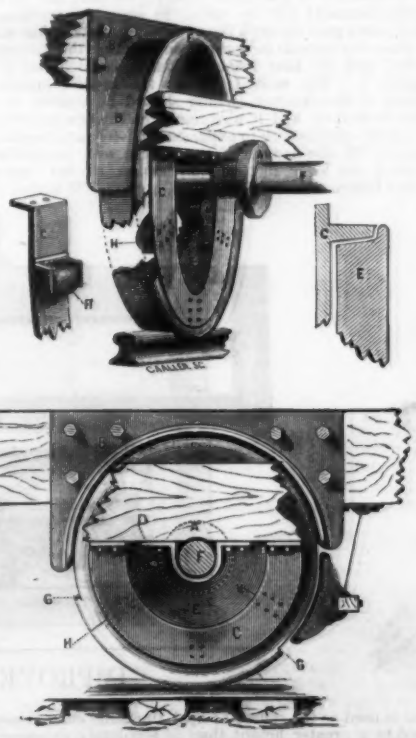
The length of the tunnel, constructed at that part of the Elba where it is narrowest, will be 1,300 meters. The carriageway will be five meters in width, and have 1·6 meter footpaths at the sides. The top of the arch will be 9·28 meters below the level of the lowest tides, so as not to interfere with the sailing of ships of the greatest tonnage. The tunnel will be reached at each terminus by means of an incline carried up to such a level as to prevent any chance of inundation. The tunnel will be covered for the first 51 meters of its length with metal. The masonry of the arched part beneath the river will be covered with a sheath of metal. The tramway track will continue as far as the Bourse, and be an elevated one from the extremity of the south incline of the tunnel to its terminus.

For this sort of structure the type of elevated railways employed in New York city will be adopted. It is calculated that the trains shall run on this road at a speed of half a kilometer per minute, which would give 13 minutes as the time necessary to make the entire trip (including stoppages) from the port to the palace of the Bourse. The estimated cost of constructing this double track is 32,000,000 francs. It is thought that the work may be executed in five years and a half.—*Annales des Travaux Publics*.

IMPROVED RUNNING GEAR FOR CARS.

MR. JOHN RADDIN, Lynn, Mass., has designed the improvement here illustrated, for which the following important qualities are claimed:

The axles being provided with collars, A, and boxes, D,



in case of breakage of either end it is held in position and will continue to run the same as though it was not broken.

A plate, B, secured to the truck frame, and coming down about half way on each side of the wheel, about three-eighths of an inch space between the wheel and plate, in case of the axle breaking the plate will drop easily on the wheel and push it along with the train.

The supporting plate, C, with its rollers secured to the truck frame on the inside, to keep the wheel, E, plumb and the lip against the rail preventing its tripping and getting off the track.

By the combination of plate, B, and supporting plate, C, collar, A, box, D, and axle, F, secured to the truck frame, it will be readily seen that either axle or wheel will continue to run without accident.

The above application to the running gear of cars will prevent serious results from the breaking of either an axle or a wheel, and the cars may run as safe as though they were not broken for twenty-five or fifty miles.

AUTOMATIC INDICATOR FOR SIGNALING THE PASSAGE OF TRAINS.

MESSRS. DUCOUSSO BROTHERS have invented an automatic apparatus for signaling the passage of a railway train

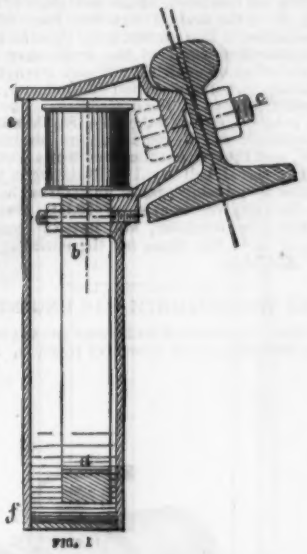


FIG. 1

at any given point, and which, since last April, has been submitted to continuous trial on the Railway of the North, under the direction of M. Banderali, one of the company's engineers. This apparatus appears to be free from the inconveniences connected with all other apparatus of the

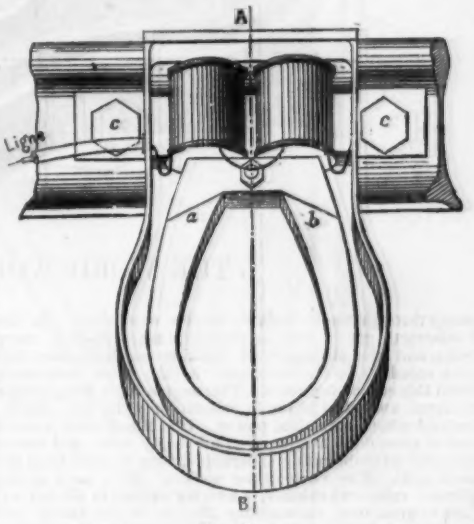


FIG. 2.

kind that have hitherto been devised. It consists of two principal parts: (1) of a *transmitter*, placed on the track; and (2) of a *receiver* installed at the point at which the arrival of trains is to be announced.

The transmitter is really a magneto-electric generator of

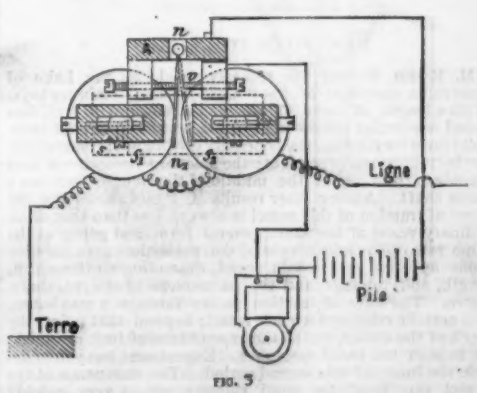


FIG. 3

induction currents, which, without shock or contact, is simply influenced by the presence of the train. It consists of a strong magnet, *a b* (Figs. 1 and 2), whose poles are provided with bobbins, and which is placed in a brass box provided with projections that permit of its being fixed to the outside of the rail by means of bolts, CC, and at such a height that the poles are nearly flush with the upper level of the rail without being touched by the rims of the car wheels.

The bobbin wire is connected on the one hand with the earth, and on the other with the bobbins of the receiver.

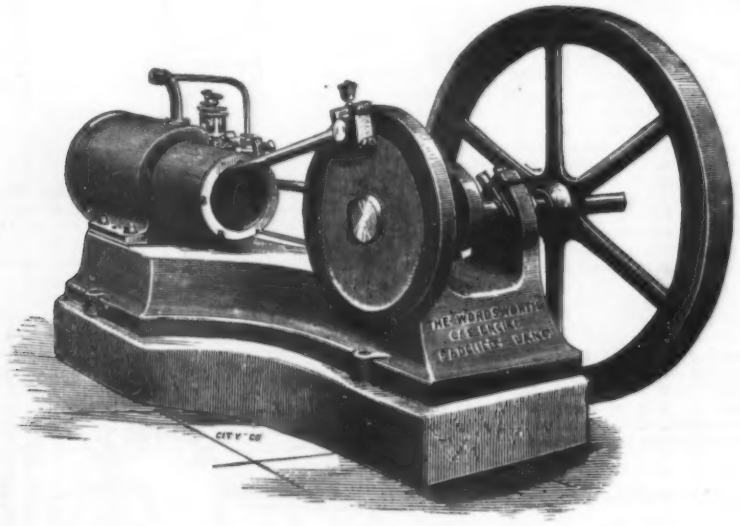
This transmitter gives a series of brief currents, that are alternately reversed. It has been changed slightly in form since the beginning of the experiments with it, but the receiver remains the same. The magnet is now no longer curved, as it was at first, and the box in which it is inclosed is made in a single piece and closed by soldering, and is filled with paraffine to prevent the ingress of water. The bobbins contain 18,000 revolutions of wire 0·14 mm. in diameter, and each has a resistance of 3,780 ohms, or an internal resistance of 7,560 ohms for the apparatus.

The receiver is a Siemens polarized relay. The armature, nn^1, is mounted by means of a pivot on the pole n, of a magnet, A, bent at right angles, and represents a north pole between two poles, S^1, and S^2, that are formed by the curves of the electro-magnet, which is fixed by its breech on the horizontal extremity, S, of the magnet, A.

When at rest, the armature, nn^1, is held slightly inclined to the left (Fig. 3) by the mutual attractive force of the north and south polarities. The current sent into the receiver by the passage of the first wheel of the train over the transmitter has the effect of weakening S^1 and strengthening S^2, and the armature, n, being attracted by the latter, moves and takes the position shown by the dotted line. The armature, when freed, is much nearer to the pole, S^2, than it was to S^1 in its first position, and it remains, then, abutting against the screw, V, and thus closes the circuit of a local pile connected with a signal bell until it is brought back to its former position by pressing against an external button. The bobbins of the receiver consist of 18,000 revolutions of wire 0·08 mm. in diameter, and have a resistance of 3,460 ohms, or of 6,920 ohms for the entire apparatus.—*La Lumiere Electrique.*

THE WORDSWORTH GAS ENGINE.

THE difficulty experienced with some gas engines is that of obtaining uniformly even speed of rotation, a difficulty



THE WORDSWORTH GAS ENGINE.

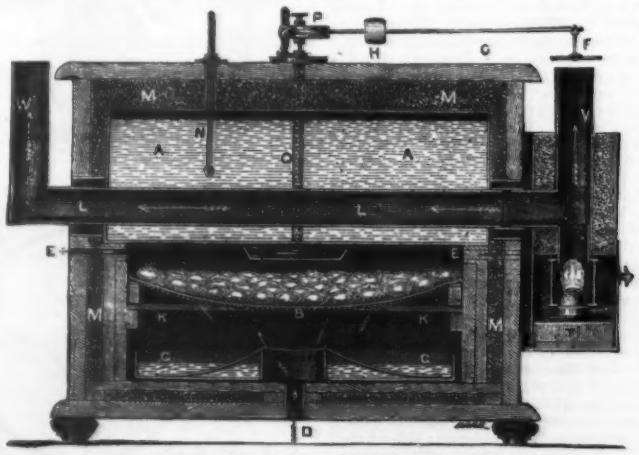
arising through the irregularity of the explosions. In the Wordsworth gas engine, an explosion takes place at every stroke, and the steadiness of working at both slow and quick speeds is further increased by the extra long trunk which this engine possesses. This engine has a long stroke and large area of cylinder in proportion to its size, and indicates double the nominal power. It is fitted with a novel kind of governor when required for steady work, and has an improved self-lubricating apparatus driven by cord from the crank shaft. The whole of the working parts, such as the cylinder valve and exhaust, which are subject in all gas engines to great heat, carbonizing the oil on the valves and causing their abrasion, is kept perfectly cool by the circulation of water, thus avoiding the necessity of continually stopping the engine to clean it. These engines, which are suitable for small powers, are of simple and strong construction, and are being introduced in London by Messrs. Hopkinson and Prince, of 15 Walbrook, and one of them, of half horse-power, is at work at the Crystal Palace Exhibition.—*Iron.*

NEW FORM FOR BOATS.

M. RAOUL PICTET has recently tried, on the Lake of Geneva, a specimen of his "rapid vessel." *Nature* says: With a length of about 67 feet, and a width of 13 feet, this vessel is peculiar chiefly in having a bottom that is of parabolic form lengthwise, the concavity downward; transversely the bottom is nearly straight; the sides are vertical. A keel reaching from about the middle of the length incloses a screw shaft. Among other results M. Pictet shows that the force of traction of this vessel is always less than that of an ordinary vessel of the same general form and going at the same rate. The advantages of the parabolic curve only become apparent at a certain speed, depending on the width, length, and tonnage, and the parameters of the parabolic curve. The force of traction passes through a maximum, at a certain velocity for each vessel; beyond that point, the work of the motor, and so the expenditure of fuel, diminishes, though the speed increases. Experiment has yet to decide the limits of this second period. The emergence of the vessel, very small for small velocity, grows very quickly when a speed of five meters (say 17 feet) per second has been reached; and it converges rapidly toward an upper limit. The recoil of the screw for different velocities increases to a maximum, then constantly diminishes and tends to become *nil* for an infinite velocity. For other features of the action we must refer to the original. The engine we note proved faulty, and in several of the experiments the vessel was towed by a steamer, at velocities rising to 27 kilometers (say 17 miles); when this last is reached, an economy of one-half is realized (growing from 16 kilometers).

IMPROVED INCUBATOR.

HATCHING the eggs of poultry and certain game birds by means of incubators is an industry which has grown into considerable dimensions during the past ten years—perhaps because the demand is so great, and perhaps also because the means of carrying it on have been vastly improved. Our own pages bear witness to the fact that a great deal of interest is taken in the subject, and as we have previously described other incubators, we now give from the *English Mechanic* some particulars of Hearson's champion incubator, an apparatus which has been long enough in existence to have undergone a severe trial, and which has proved itself to be second to none. Other things being equal, it is well understood that the method of regulating the temperature is the distinguishing feature on which the relative merits of incubators depend; for it is clear that, unless the apparatus is to be very troublesome, there must be some arrangement by which the temperature can be steadily maintained at 102°–104° Fahrenheit, when required, and regulated to suit the processes going on within the eggs. When it is remembered that the operation of hatching the eggs of fowls runs over twenty-one days, and that a few hours' neglect on the twentieth day may ruin the whole "nest," the importance of having a really trustworthy incubator can be readily appreciated. In the annexed engraving we give a longitudinal section of Hearson's champion incubator, the distinguishing feature of which is the capsule, S, and the accessories by which the temperature is regulated. The capsule is a little vessel of flexible metal, exposing large surface compared to its contents. It contains about 30 drops of a liquid which boils at the highest range of temperature desired in the drawer of the incubator, and consequently, when that temperature is reached the flexible side of the capsule expands or is puffed out, giving motion to a needle, O, which acts on the lever, G, and opens the damper, F. In the engraving, for clearness the lamp is shown with a vertical chimney and a horizontal tube leading out of it and passing through the water-tank, when it turns up to the air; in practice the tube is returned to give more heating surface, and to bring the two chimneys side by side. In ordinary working the heated gases pass through the tube, L, and warm the water; but when the capsule is brought into action the damper, F, is lifted and the heat from the flame shunted out by the chimney, V. The weight, H, on the lever regulates the opening of the damper, which should be limited to one-eighth of an inch, and it also regulates the temperature, for the capsule commences to expand at 97°–98°, and would consequently lift the damper if the weight were not shifted so far along the lever that a temperature of 104° must be reached before the damper begins to open. Whether lamp



IMPROVED INCUBATOR.

or gas is used as the source of heat, the flame must always be turned to a greater height than is absolutely necessary, so that there shall always be a little heat to shunt. The other parts of the apparatus will be clearly understood by the following description: A is the water in the tank; B, perforated metallic movable egg-tray; C, water-tray for damping the air which enters by D, and passes through a piece of coarse canvas which filters it; E, ventilating holes, to insure a full supply of fresh air; K, slips of wood for varying height of egg-tray; M, non-conducting material; N, thermometer; P, milled head screw for adjusting the needle and lever; S, capsule; T, lamp.

BULL'S IRON AND STEEL DIRECT PROCESS.

WE are informed by the secretary of Bull's Iron and Steel Company, Limited, of Liverpool, says *Iron*, that a contract was entered into between them and a syndicate of American gentlemen who wished to purchase the patent for this process for the United States of America. It was stipulated that Mr. A. Hansen, of Dortmund, Prussia, who was for many years at one of the largest steel works in the United States, should have an opportunity of investigating the process, and if his report was favorable, the American syndicate would at once erect furnaces in the United States, and carry out their contract. The following is a copy of Mr. Hansen's report, which has been forwarded to America. We understand that a company has already been incorporated in New York, and a furnace will soon be in operation there.

Bull's process, as known, consists in making pig-iron and steel ingots in a blast furnace direct from the ore, using water gas as the reducing agent, instead of the solid carbon now used in the ordinary blast furnace. There can be no doubt that all the different methods of burning fuel, from the very earliest time up to the present, as used for all purposes on a large scale, are most incomplete and unsatisfactory, and that this particular branch has remained far behind the immense progress made in all other branches of science and invention. The question how to get a more complete combustion of fuel has been already a matter which has engrossed the time and attention of the leading scientific men of the world, and when it is considered that more than forty million tons of coal are annually consumed in the production of iron and steel, it will be seen what a vast field these two great industries present for carrying out the improvements which have been made from time to time for the purpose of lessening the requirements of coal in our blast furnaces, and in the making of steel.

Sir Henry Bessemer and Dr. Siemens have led the way in economizing fuel in the making of steel, while Mr. J. Lowthian Bell and other of the English North Country ironmasters have been able to greatly lessen the quantity of coal required to make a ton of pig-iron, but Bull's process of heating and calcining the charge makes a large increase in the economy of fuel over any of the methods named above. As water gas is of such importance for all heating purposes, and as there is no doubt of its becoming our general heating material in the future, I must enter into some description of it before reporting upon the results obtained by Bull's process at Seraing. Some of the different points and advantages in favor of using water gas as a reducing agent in the manufacture of iron and steel, which I can gather from my own experience and experiments, and from any scientific works or sources known to me, are as follows: For a long time no great improvements, or any of much importance, were made in the more complete combustion of fuel until water gas was proposed as a substitute for the coal now used for manufacturing purpose. Water gas, as known, is obtained by conducting superheated steam through coal, which has previously been burnt to a red or white heat. In the first place, gas producers containing solid carbon in any form are subjected to an intense heat by the means of a stream of air passing through them. In the second place, the air is shut off, and, instead of this, superheated steam is conducted into the producers, and by this means water gas is generated. The gas is generated as stated above just as long as the coal is at a sufficient heat to produce the gas, and then the steam is shut off and the air reintroduced; but by having several producers charged at different times, a constant stream of gas is discharged. The gas thus obtained and discharged theoretically contains carbonic oxide and hydrogen (CO and H_2) in equal volumes. Practically gas has been obtained containing about from 2 to 6 parts carbonic acid, 35 to 40 parts carbonic oxide, 55 to 60 hydrogen, and 0·5 to 3·0 air. The gas produced in a Siemens, or ordinary, producer contains about from 2 to 6 parts carbonic acid, 23 parts carbonic oxide, and 65 parts nitrogen. There can, since the nitrogen takes fuel to heat it, be no doubt, upon comparing water and ordinary gas, that water gas is far superior, containing, as it does, only about 0·35 to 2·3 of nitrogen, against the 65 contained in ordinary gas.

Therefore, to sum up in figures the advantage of water gas over ordinary gas, I must state that ordinary gas contains about one volume of carbonic oxide and 2 volumes of non-combustible nitrogen, whereas water gas contains 1 volume of carbonic oxide and only ·023 of non-combustible nitrogen. When complete combustion of the fuel is obtained, the water gas produced contains 92 per cent. of the heating power contained in the solid carbon used, whereas ordinary gas would only contain 70 per cent. of the same. It is also probable that after further experiments with water gas, gas may be produced which may contain the whole of the heating power contained in the solid carbon used to make it. The temperature obtained by burning water gas with air amounts theoretically to 2860°, and in using ordinary gas only 1980° is obtained. These few facts go to show conclusively that water gas is far superior to any other gas, and that after a short time it must become more and more used for metallurgical and other purposes, more especially when we bear in mind that the one great step toward its general use has been taken through the fact that ordinary gas has been already used to advantage.

DESCRIPTION OF BULL'S PROCESS.

Bull's process, as it is termed, of calcining and heating the charge, by which a great increase is obtained in the output of the furnace, without increasing the expense of working either in labor or fuel, is a system in which no solid carbon is used in the furnace, which is charged with nothing excepting the ironstone and the lime for fluxing it. The furnace is worked exclusively with gas in a very highly heated state direct from the producers, the chambers of which are constructed with a lining of fire-brick, or equivalent material, surrounded by a common brick or similar casing, and a metal casing, spaces being left between the lining and the common brick, and between the common brick and the metal casing. The conduits and valves which convey the gas from the producers to the blast furnace are lined with non-conducting materials. One of the leading features in connection with the method is the mode of obtaining the various qualities of metal. In working, the charge in the furnace is maintained at different heights to produce different amounts of carbon in the metal, the carbon itself being derived from the carbonic oxide in the gas which ascends from the hearth through the ore in the furnace, so reducing the ore to a metallic state, and impregnating it with carbon. Highly heated air is also introduced in sufficient quantities to burn about 10 per cent. of the gas, and maintain the furnace at the high temperature necessary to allow the withdrawal of the iron or steel and cinder in the fluid state. The gases being obtained entirely outside the furnace, there is no zone of gasification, but only the zones of fusion, reduction, and carbonization. You can very easily convert an ordinary blast furnace to work the Bull process. There is a calcining oven open at the top for feeding the charge, and for the escape of the aqueous vapor given off from the charge while calcining. By this means the ore and flux are delivered into the furnace in a dry and highly-heated state without additional labor or cost of fuel, therefore the waste gases given from the furnace are comparatively free from aqueous vapor, and are thus capable of producing an intense heat by their combustion in the air-heating stoves.

OPINION UPON BULL'S PROCESS IN GENERAL.

One of our most important metallurgical processes is the blast furnace process. From the earliest time up to the present day the manufacture of iron has always been of the greatest importance, and in our own time enormous quantities of iron are annually produced, and great improvements have been made in the blast furnace and other things connected with it. It is my opinion that Bull's process will be of the greatest importance in the manufacture, if not of all kinds, certainly of many kinds of iron and steel, and must be soon universally adopted. In a blast furnace ores are reduced to metallic iron by carbonic oxide, derived from the burning of coke. Mr. Bull uses, as mentioned above, water gas, which is a much stronger reducing agent than carbonic oxide, because it consists of carbonic oxide and hydrogen in equal volumes: the heat obtained in the furnace mentioned above must consequently be much more intense when water gas is used instead of coke. This is of great importance, and by the use of water gas sufficient heat can be obtained to keep even steel in liquid state.

It can, therefore, not be denied that the principle of Bull's process is right, and that it must be the process of the future. From what I know of it there is no difficulty in making water gas, but wherever it has been used it has not hitherto proved economical. This, however, should not be any reason to drop the matter, because theoretically all the arguments are in favor of the method of using water gas as fuel. Even taking into consideration the fact that 8 per cent. of the amount of heat which carbon contains is lost in the manufacture of water gas, still ordinary gas shows a loss of 29 per cent., and still has proved more economical than burning solid carbon. The use of water gas on a large scale being quite a new thing, no doubt improvements will be rapidly made, and any practical difficulties overcome, as it has been lately with all new inventions, and Bull's process seems to overcome all the difficulties hitherto experienced.

Now in regard to the apparatus and plant for producing water gas, which is one of the main points of the Bull process, Mr. Bull seems to have overcome most of the difficulties hitherto experienced, and is able by his later patents to make water gas in a very economical way. I am sorry not to have been able to see the experimental furnace at Seraing in operation, which would have enabled me to confirm this opinion; judging, however, from what has been laid before me, and all the information I can gather, Mr. Bull's patents for water gas producers show many important improvements. The process itself will no doubt yield a much larger output on account of the stronger reducing gas used as described before. Another great advantage is that coal of any quality, even the most inferior kind, can be used without being coked beforehand. Less air is required, consequently less nitrogen passes through the furnace. The hot stoves, judging by the drawing, are got up very nicely, and promise to work well.

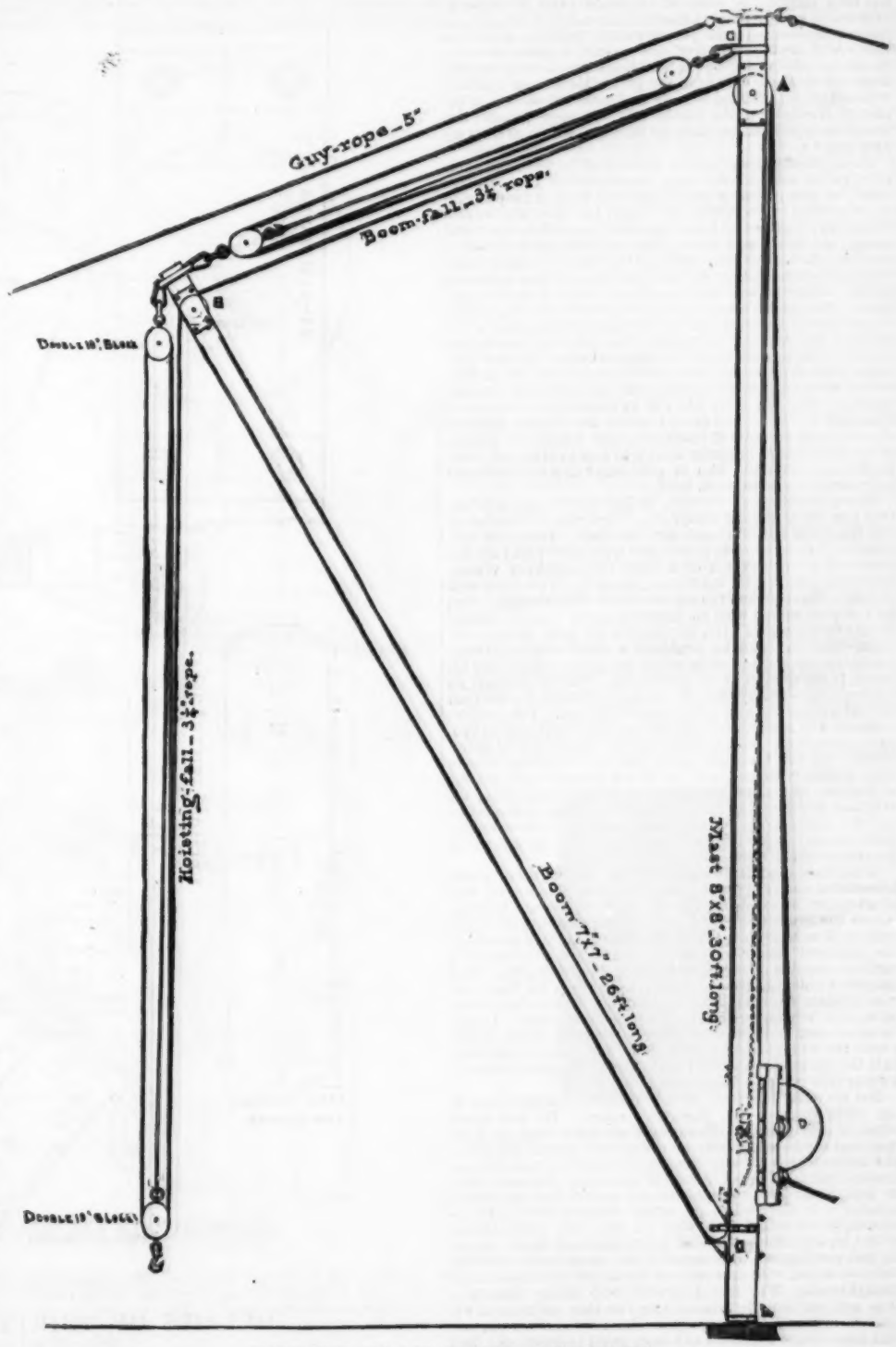
Opinion upon results obtained in the experiments made at the works of the Societe John Cockeril, at Seraing: The results, including explanations of the same by the inventor, are hereunto attached. I have thoroughly investigated and studied them, and I will now make a few remarks about them. I regret very much, as mentioned before, that I have not had a chance to study the Bull process when it was working at Seraing, because I should then be in a much better position to say more about the decided economy of the process. However, judging from the pig-iron, and almost steel, that has been produced at Seraing under circumstances which were most disadvantageous, and keeping in mind the fact that the economical results were not accomplished at the start, but gradually brought to the immense economy shown in the results attached, I am of the opinion that the desirable results will be got after a short time, and after improvements, which may be found to be necessary, are made. Bull's process will undoubtedly make superior pig-iron very much more economically than any other process, and will be of such importance in the future that I can recommend it to any parties who wish to keep pace with the progress made in the manufacture of iron. As far as steel is concerned, it is not yet proved beyond doubt whether it will be possible by the means of this process to answer every purpose required; however, the results obtained at Seraing show that it may be very possible to make excellent tool steel. The process being entirely new, I should not recommend any parties who want to start to commence with a large furnace, say for instance the size proposed in the contract, but should advise them to erect a small furnace capable of turning out, say, 100 tons per week, and in this manner train their men to the process, and get them fit to work the large furnace, with any necessary improvements when erected. In conclusion, I may say that at Seraing, in an ordinary blast furnace, fitted with Cowper hot-air blast stoves, and ordinary water gas producers, of the cupola type, the process was tested, and with the most satisfactory comparative results as regards the quantity of fuel used and the output of metal. In the course of twenty-four hours five times as much iron was produced by the process with the gas as there was in an ordinary furnace without the gas. This shows the valuable nature of this, the most recent discovery for making iron and steel direct, and effecting a great saving in the consumption of fuel. It is only fair to expect that working under more advantageous circumstances, and with Mr. Bull's improved apparatus, the results will be still more favorable to the process. The success already obtained, there is every reason to believe, will cause the Bull method to be adopted in our own and the English mining districts, seeing that it has advantages that cannot well be claimed for other processes.

THIRTY-FOOT HAND DERRICK.

By T. APPLETON.

WHILE it may not be the best that could be designed, it is convenient, easily and cheaply constructed. There are many occasions for using a light, portable derrick, when one would not consider it worth while to set up a large one, such as you illustrated recently. For instance, in digging a well, take the thirty-foot derrick with a single block to raise the tub, remove the crank shaft and drum and in their place attach a snatch block; then, with a good pair of horses, you can hoist a tub full of earth quickly, and swing it so as to dump forty feet away from the well.

For loading and unloading stone or heavy timber, or for building a heap of coal, as well as building masonry under a bridge, a small derrick will save its cost in a year. Of course a large derrick is much better for big work and is oftentimes indispensable, but such a one as my drawings represent will prove to be "a handy trick," as they say in Texas.



THIRTY-FOOT HAND DERRICK.

THIRTY-FOOT HAND DERRICK.

Mast 8 in.×8 in., 30 ft. long, square timber corners chamfered off except when gearing and sheaves are attached. Boom 7 in.×7 in. or 8 in.×8 in., 26 ft. long, corners chamfered off except at base. Butt to be rounded to a half circle with pinhole at the center of circle. At A are two 10 in.×1¼ in. sheaves, one on each side of mast. Hoisting fall passes over one and boom fall over the other. At B is a single 8 in.×1¼ in. sheave attached to the boom in the same way as those at the mast-head; if preferred, this sheave could be placed in a mortise through the center of the boom. At C is a cast-iron bracket with rib at top and bottom, secured to mast by three bolts, two above and one below. The U-shaped band passing around the mast holds the boom in place, but the bracket supports all the weight. The detail drawings will, I think, explain the construction of the remaining parts. The design was to make all the iron work as simple as possible, and strong enough for the work. The step casting should be bolted with three-quarter inch lag screws to a block of oak, say 16×20 in. and 4 inches thick. There should be two bolts through the oak piece horizontally, projecting 4 inches on each side, to serve as fulcrums for bars in moving the derrick. I do not claim anything about this derrick as original with me, and many of your readers may know of better ones, but as I have the drawings on hand you are welcome to the tracings sent.

For guys I would use 400 feet of 5 inch rope, a hook to be spliced on to one end of each guy. For hoisting fall and boom fall, say 500 ft. of 3¼ in. rope. For blocks you will need two plain double 10 in. blocks, one ditto with becket, and one ditto with becket and loose swivel hook.

In regard to hoisting engines, if you have a winch head on the down shaft, and have a loose drum instead of a loose pinion, as some engines have, you can handle two falls at the engine, but this requires an extra man to the line on the winch head. An engine with two drums would be better, also heavier and more costly.—*Engineering News.*

ACCORDING to the report of the Düsseldorf Chamber of Commerce, the turkey-red dyeing establishments of that district did not have a profitable business in 1882, and this on account of the over-production, which brought, of course, the prices to a low level. The German turkey-red dyers now take, according to the above report, little share in the export trade of turkey-red dyed yarn to India.

JAMES NASMYTH.

THE inventor of the steam hammer has been conspicuously the right man in the right place. James Nasmyth was the child of the era inaugurated by the opening of the Liverpool and Manchester Railway in September, 1830, and he was the parent of many of the inventions which have contributed to the wonderful progress made in the mechanical arts during the past fifty years. With the adoption of railway locomotion and the rapid development of steam navigation, it was soon found that the method and appliances which had done duty up till then were not adequate to the demand upon them. There was a call for machine-making tools of increased power and precision, and on more than one occasion Nasmyth proved his possession of an admirable resource by the ready response with which he met the want. We should not be doing justice, however, to his foresight, if we omitted to mention at the same time how often he had paved the way, by the invention of some simple but ingenious contrivance, for the realization of the perfection to which machinery has been brought nowadays. If his life does not present a record of fierce battling with difficulty and failure, such as has so often been the only road by which success has been attained by many of his predecessors in the ranks of inventors, yet it amply illustrates the value of diligent and patient application and perseverance, qualities which, as they are at the foundation of this country's greatness as an industrial nation, we would fain hope are as ever present with our workers now as in the past. How these qualities were employed, and led to early and deserved success in the case of Nasmyth, could not be told in a more graphic and straightforward manner than by the pages before us from his own pen.*

James Nasmyth was born at Edinburgh in 1808, and came of a gifted family. He early manifested a very decided taste for mechanical pursuits, and was fond of frequenting the workshop of his father, for though the latter was by profession an artist and architect, his chief relaxation was found among his lathes and tools. The son's natural bent took a practical turn at an early age, and he drove a small trade among his schoolmates in the spinning tops and miniature cannon which he was able to turn out in his father's workshop. Among his school companions were two of a similar disposition to his own, and in the foundry belonging to the father of one, and the laboratory of the other, he had further room for the indulgence of his especial tastes. James Nasmyth inherited no inconsiderable amount of the artistic ability which was in the family, and his father took pains to cultivate this, and train his eye to form correct images of whatever he saw. The faculty which he thereby acquired of producing an exact delineation of any conception formed in his mind was of immense service to him in after life in his profession, and stood him in good stead in a very different manner on one occasion at least.

When traveling in Sweden, he had to put up at a primitive inn, the hostess of which was as ignorant of English as Mr. Nasmyth was of Dannemora Swedish. The latter had, therefore, recourse to his pencil, and with a few rapid strokes produced a little sketch of a table with smoking viands, knife and fork, bread, bottle, etc., upon it. The good wife at once comprehended the nature of her visitor's wants, and he was soon served with an excellent repast. As the young Nasmyth grew into a lad, his handiwork took more ambitious directions, and he produced a small working steam engine for the purpose of grinding the colors required by his father in the pursuit of his profession. This performed its duties so successfully that the young mechanician received several commissions for similar small engines. For these he obtained £10 apiece, and with the proceeds was able to procure admission to various classes at the university of Edinburgh. By this time his career may be considered to have been definitely shaped, and he threw himself with all the enthusiasm of a young man into the work of improving his skill and knowledge. He got up early to labor at the lathe, and the nights he spent in making castings in his bedroom, while the days were similarly employed when he was not at his classes at the university.

When he was nineteen years old, and the matter of steam locomotion upon the public roads was occupying a good deal of attention, he exhibited a small model of a steam carriage before the Scottish Society of Arts, the members of which were so pleased with the little machine that they presented the youthful maker with £60 to enable him to construct a carriage capable of conveying five or six passengers. This extensive order, as it was looked upon then by Nasmyth, was satisfactorily completed in about four months, and many successful trips were made by the steam carriage. It may be mentioned that Nasmyth utilized the waste steam to improve the draught, although he was not aware at the time that George Stephenson had made use of the same means to increase the power of his engines.

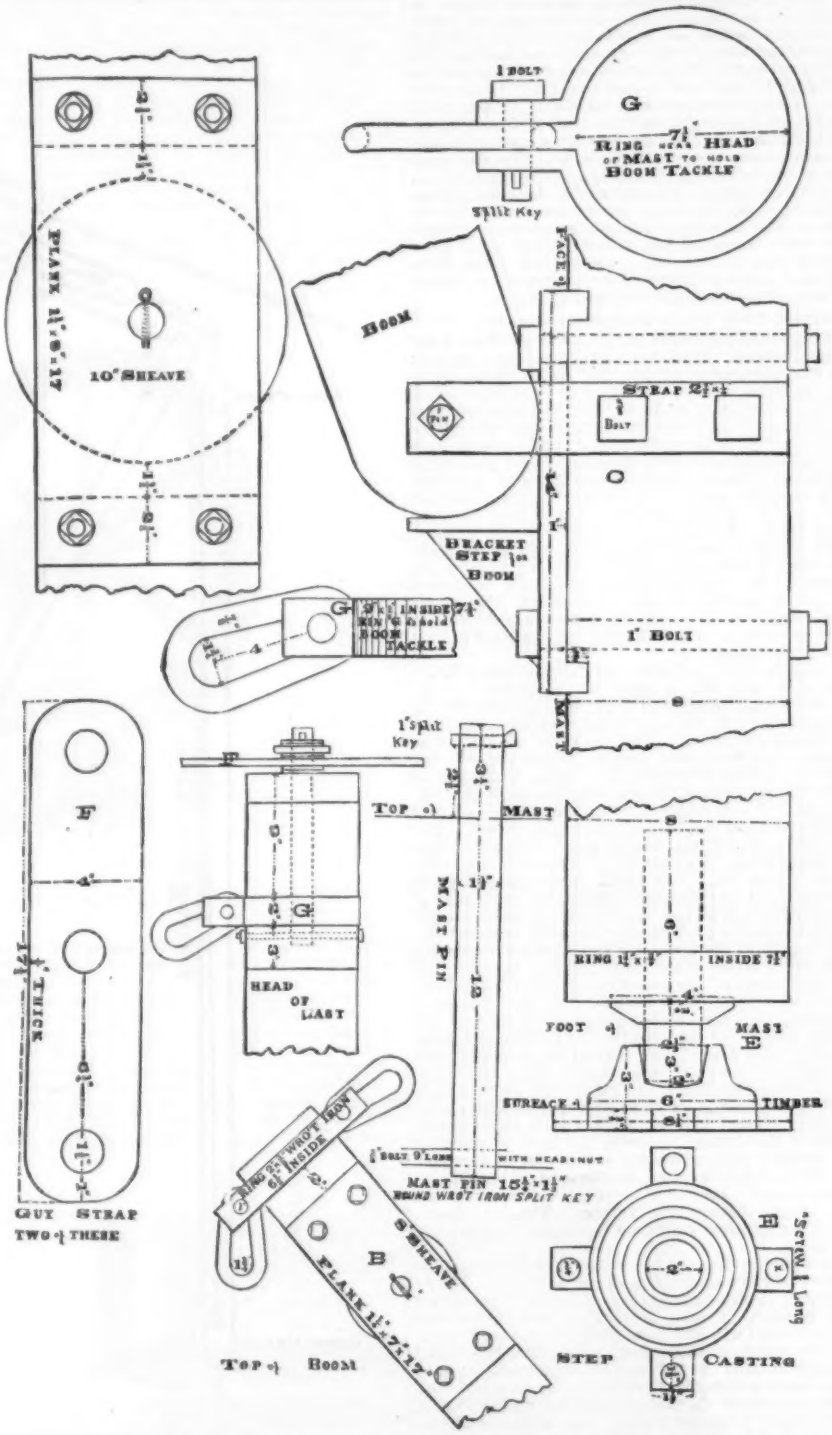
But we must pass from these interesting reminiscences of the early years of Mr. Nasmyth's career. He had heard often of the fame of Maudsley's machine shop in London, and of the superiority of the articles turned out there. He learned that it was due to the employment of mechanical tools to effect much of the work hitherto done by hand, and an irresistible desire seized him to obtain admission to the workshops of the London firm. He accordingly set out for London on May 19, 1829, taking with him a working model of a high-pressure engine which he had constructed with especial care on purpose. He was likewise armed with specimens of his ability as a mechanical draughtsman. The first interview with Henry Maudsley was not particularly encouraging, as that gentleman explained to him the determination which he and his partner had come to not to receive any more pupil apprentices. But permission was obtained to exhibit the model which had been brought up, and so highly pleased was Mr. Maudsley with the workmanship that after a week's holiday young Nasmyth was duly installed as Mr. Maudsley's assistant. To be thus thrown into intimate association with such an eminent engineer was no doubt a circumstance of great benefit to Nasmyth, and he acknowledges with generous warmth his appreciation of the advantages he derived from it. But he was ambitious to start business on his own account, and after remaining with the firm a little over two years, he returned to Edinburgh. Here he secured a small workshop, where he set to the task of extending and completing his stock of tools. While engaged in this undertaking, he took in various odd jobs, to assist him in obtaining the requisite means for the accomplishment of his object. These necessarily caused a little delay in the execution of his principal design; but at last, after several months' labor, he found himself furnished with a complete equipment of tools, and then he began to look about to discover the most suitable locality for the foundation of such a business as he projected, viz., that of a mechanical engineer and machine tool maker. After some search he settled upon Manchester; there he leased a small flat in Dale Street, whither his stock of tools and machinery was speedily brought, and then the future inventor of the steam hammer was ready to commence work, with his modest staff of one assistant.

Between this time and the end of 1856, when Mr. Nasmyth retired from business pursuits, at the age of forty-eight, was embraced the most important part of his life. Within this period was produced the majority of the numerous inventions and contrivances with which he enriched the mechanical arts. Business prospered with the young engineer. There was a large demand for machine tools, in a great part consequent upon the difficulties with the workmen about this time, and the desire to be placed as independent of these as possible, and James Nasmyth soon found his premises growing too small for the amount of work on his hands. An accident to the floor, caused by moving a heavy piece of machinery, and which occasioned great consternation to the tenant of the lower part of the building, hastened the inevitable removal of the workshop to more commodious premises. Mr. Nasmyth cast about him, and his choice fell upon a plat of land bordering on the Bridgewater Canal, and adjacent to the Liverpool and Manchester Railway. Of this he obtained a favorable lease, and commenced the erection of the necessary buildings. This was the nucleus of the Bridgewater Foundry, afterward greatly extended as the growth of the business demanded more accommodation. But space will not permit of our following Mr. Nasmyth step by step in his progress toward prosperity and fame. We must pass on to the time when he gave to the world the invention with which his name is most closely associated.

His firm had executed various orders for locomotives for the Great Western Railway, the directors of which company had ordered the construction of a steamship of unprecedented size for their line between Bristol and New York. While the engines for this ship, the Great Britain, were being built, a difficulty presented itself. The wrought-iron intermediate paddle shaft was required of unusual size, and the engineer in charge of the work found, to his dismay, that there was not a firm in the length and breadth of the land that possessed machinery capable of forging such a piece of work. In the dilemma, application was made to Mr. Nasmyth. He saw that the only difficulty lay in the want of range possessed by the forge hammers then in use. He set himself to work, and in little more than half an hour had completed a drawing of his steam hammer, which comprised all the essential details of the invention. No more admirable illustration could be afforded of the fertility of resource and the quick-wittedness which have been such prominent characteristics of Mr. Nasmyth. But the invention was not immediately called upon to prove its worth. The idea of fitting the Great Britain with paddle wheels was abandoned, and she was furnished with a screw propeller.

The iron trade throughout the country was so depressed at the same time that Mr. Nasmyth could not secure a single order for one of his hammers, although the merit of the invention was cordially recognized by many ironmasters. Better times, however, came eventually over the iron trade, and the Nasmyth steam hammer was extensively adopted in this country and the United States. Before this came about, Mr. Nasmyth had the unexpected gratification of finding his invention doing good service at the Creusot Ironworks, in France, one of the managers of which had been allowed to copy the designs at the Bridgewater Foundry some time previously. The manner in which reference is made to this episode, when accusations of piracy might have been indulged in, is characteristic of the man. It would be impossible and out of place to refer here to the forty and odd inventions and schemes which Mr. Nasmyth's fertile brain gave birth to, but there is one which we cannot avoid noticing, as it was an ingenious adaptation of his steam hammer—we mean the steam pile driver which was used with such good effect at the construction of the docks at Keyham. At the test trial which was made of the new apparatus, Mr. Nasmyth drove in his pile in four and a half minutes, while with the old appliances it took twelve hours to drive down the other pile.

Reference has been made to Mr. Nasmyth's powers with the pencil, and there can be little doubt that, had he chosen to follow in his father's footsteps, he would have been an excellent artist; the specimens of his skill which are given in the volume before us bear witness to this. A well earned leisure during the latter part of his life has been largely de



DETAILS OF THIRTY-FOOT HAND DERRICK.

*James Nasmyth, Engineer: an Autobiography. Edited by Samuel Smiles, LL.D. London: John Murray, 1883.

voted to astronomical pursuits, which have not been without practical value, as is demonstrated by the discovery made by him of the willow-leaf shaped objects which cover the sun's surface, and by his book upon the moon, published in 1874. The record of Mr. Nasmyth's life, told as it is in his own simple, straightforward language, is a book which should be in the hands of every young mechanical engineer; but it will also amply repay perusal by the general reader, who cannot fail to find it instructive and interesting in a high degree.—*London Iron.*

RICHARD TREVITHICK.

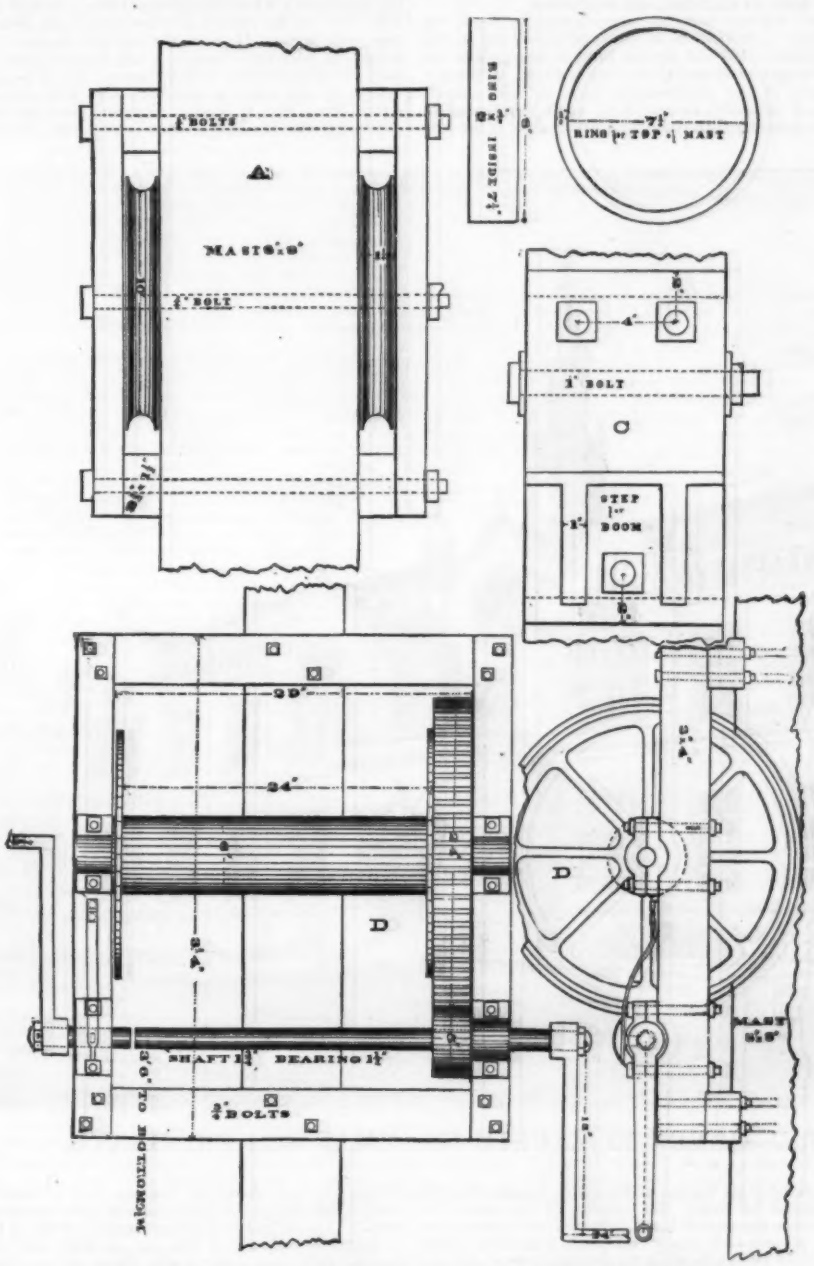
ON the 22d of April, 1833, Richard Trevithick, engineer and inventor, died at Dartford, in Kent. Not a relative stood at his bedside; not a penny was in his purse. Messrs. Hall's workmen were the bearers of his coffin, and the mourners at his funeral. For the last offices he was indebted to strangers. Thus passed away from among us a man beyond all doubt or question a genius; a man who possessed not only astounding fertility in invention, but an idomitable and fiery energy which bore down all opposition, and brooked no contradiction even from the powers of nature themselves. Trevithick was made of the same stuff as that from which some of our greatest preachers have been hewn. Had fate so ordered it, he might have been a preacher, a martyr, a soldier—he might have been anything, in short, with a mission, a work to be done, a kingdom to be overcome. As it happened, he was an engineer, and he attacked mechanical problems with a courage and pertinacity which carried all before them. If others could but have kept pace with Trevithick, he would have been even a greater man than he was; but the world lagged behind. Who but a genius would have had the audacity to attempt to work with steam of 120 lb. pressure, at a time when a boiler plate two feet square was looked upon as a curiosity? Who but a man of abnormal courage would have dared to work engines under the conditions which Trevithick accepted for the moment as inevitable? James Banfield, for many years principal smith to Messrs. Harvey & Co., of Hayle Foundry, said in 1813: "I was rivet boy at the making of Captain Trevithick's high pressure boilers at Millinear mine. The largest plates then to be had in Cornwall were three feet by one foot." Trevithick did much for the pumping engine in Cornwall, as did his father before him. He has been called, and with justice, the inventor of the high pressure engine, and that means much more than appears at first sight.

Up to Trevithick's time there were but two forms of steam engine in existence—one was Watt's the other Newcomen's. When Trevithick began to play a part in this world's affairs, the Newcomen engine was dying out, the Watt engine was slowly supplanting it; the first was an atmospheric engine, the second used steam of not much greater pressure than that of the air. Both relied on a vacuum for the performance of their duties. Trevithick made an engine which worked without a vacuum. He was not the first to do this, but he was very nearly the first. Leupold made high pressure engines before Trevithick. But Trevithick was the first man in Great Britain to make a non-condensing engine which was of use. His first model was made about 1796 or 1797. Between 1802 and 1804 he and his partners, Andrew Vivian and William West, received £1,250 in royalties on high pressure engines erected. He made, too, what were practically portable engines at a very early period. But perhaps his most original invention was the locomotive. In 1801 he produced a small engine which he worked at Camborne; and in 1803 Mr. Henry Vivian ran a Trevithick locomotive, built by Mr. Fulton to Trevithick's designs, from Leather lane through Liquor pond street into Gray's inn lane, past Lord's Cricket ground to Paddington and Islington, and back. Trevithick did not confine himself to inventing steam engines. He invented the first steam dredger ever used, and worked it successfully on the Thames, and he was employed as engineer to the first Thames Tunnel Company in 1807. In 1809 he invented a floating dock of iron. It would not be difficult to fill many pages of this journal with a record of his inventions and his deeds; but it is unnecessary. We have said enough to give such of our readers as know nothing about Trevithick an idea of what manner of man he was. Those who, like ourselves, are more or less familiar with his history, need no aid from us in this direction.

We have said that Trevithick died penniless, almost forgotten, wholly alone. We do not imagine that any one was to blame for this. Like all masterful men who lack mental balance, Trevithick was not one who made many friends; that he had several was true, but he held himself aloof from them. Beyond doubt he was a disappointed man. Much that he had done was apparently snatched from his grasp. His very versatility stood in the way of his success. He lacked the commercial element with which money could be made, and sympathetic characteristics, the charity of which is long suffering, without which no true friendship can be maintained. It is none the less a deplorable circumstance that so able a man should have died in want and misery; and the misfortunes which clouded the happiness of his latter years seemed to have enshrouded his very memory in a mist. There is not, perhaps, a dead engineer who has done so much, and about whom so little has been heard. In another generation Richard Trevithick will be as though he had no existence unless some step is taken to keep his memory from utter oblivion.

Trevithick was born in Illogan, Cornwall, on the 13th of April, 1771. Consequently he was but sixty-two at the time of his death. We are glad to learn that it has been resolved by influential men that a testimonial of some kind shall be devoted to his memory. Nothing has yet been determined on, but a committee has been formed, consisting of the Duke of Sutherland, Mr. Hyde Clarke, Mr. Henry Chapman, Major John Davis, Dr. Pole, Mr. Husband, Mr. Harvey, Mr. Webb, of Crewe, and Mr. Trueman Wood. These gentlemen have issued a circular, in which we find the following passage: "It has happened, in the course of events, that while there are many statues and other tributes to James Watt and to George Stephenson, no adequate memorial has been provided for another well known engineer, to whom our country and the world are indebted for many great and valuable inventions. To Richard Trevithick we owe the application of high-pressure to the steam engine, the locomotive for the railway and the common road, the steam dredging apparatus, the application of steam to traction and other purposes in agriculture, etc. Few men have ever displayed so great a fertility in inventions, and when we consider their ultimate development, few have conferred on the population of the globe such vast practical benefits. In these claims Trevithick stands unsurpassed, but although matters of history, they are little known by the public at large, and have been little regarded.

"A bust of the great engineer in the Board Room of the London and Northwestern Railway at Euston—on which spot it happened that so far back as 1808 Trevithick ran the first locomotive—another bust in the locomotive workshops at Crewe, and a medallion on the Victoria Bridge, in Canada, are the chief memorials of him. This year is the fiftieth from his death, and that is regarded as a fitting time to repair the national neglect, and also the neglect of his own countrymen in the Duchy of Cornwall, where his greatest inventions were carried out with enormous benefits to the country. The nature of the testimonial or testimonials to be provided must be determined hereafter, and be dependent on the amount of the contributions. Various suggestions have been already made, and it has been thought that, so far as the tribute is national, it should take the shape of a statue, to be placed in Westminster Abbey, while the memorial to be provided in Cornwall and Devon may include a statue in Truro Cathedral, a Trevithick school, or museum of art, or scholarship, so that his example of achievement may offer to many a further stimulus to exertion." We trust that the reply which will be made to this appeal will leave nothing to be desired. It would be better that no appeal at all should have been made, than that, being made, the response was not adequate to the occasion. In such a case as this a slur would be cast, not on Trevithick, but on the engineers, who, being asked to help to raise a monument to the memory of one who was an honor to the profession, refused. Little trouble was incurred in getting funds to raise a memorial hall to Stephenson. Stephenson possessed gifts which Trevithick lacked. Yet Stephenson's works are an everlasting monument to his memory. Nothing of his works save a few models remains to tell the world that Trevithick lived. This was the man's misfortune, not his fault. Let us now, ere his memory is forever lost in the mists of time, do what in us lies to provide such a memorial as will preserve to England first, to Cornwall next, the memory that Richard Trevithick lived and labored.—*The Engineer.*



DETAILS OF THIRTY-FOOT HAND DERRICK.

GRUNOW'S NEW CAMERA LUCIDA.

MR. J. GRUNOW, of this city, has constructed a new camera lucida, which deserves the attention of microscopists. It was described by the editor of *The American Monthly Microscopical Journal*, at a recent meeting of the New York Microscopical Society.

The instrument consists of three rectangular, equilateral

prisms, so arranged that, when placed over the eyepiece with the microscope inclined, which is the most convenient position, a portion of the surface of the work-table of the size of about twelve by fifteen inches is projected into the field of view, so as to be distinctly and clearly seen together with the object on the stage.

The two prisms, *e f g* and *h f g*, are cemented together so as to form a cube, the sides, *h g* and *f e*, being parallel. The hypothenuse, *f g*, of the prism, *h f g*, is silvered, to do away with the blue halo otherwise peculiar to this form of prism, which would greatly obscure the reflected image. The silver is removed at the center of the coating, at the point, *o*, so as to leave a clear space about half the diameter of the pupil of the eye. The other prism, *l j k*, is placed with the side, *j k*, inclined to the cube, *h g f e*, at such an angle as may be most desirable.

In viewing the object under observation in the direction of N M through the aperture at *o*, we see the whole field of view, while at the same time the drawing-board and pencil are reflected from the side, *l j*, of the prism, *l j k*, to the silvered surface, *f g*, and then reflected to the eye in the direction of P N. Both the pencil point and the object are very clearly seen without any strain upon the eye.

It is in this respect that the maker claims for this camera lucida superiority to any other form. It can be immediately applied, while the microscope is in an inclined or vertical position, without any change of conditions or loss of time. The camera is simply slipped over the eye-piece, the paper placed on the table, and the drawing proceeded with.

THE deepest coal mine in America is at Pottsville, Pa. The shaft is 1,576 feet in depth. The coal boxes, holding four tons each, are run upon a platform, and the whole weight of six tons is lifted in little more than a minute. The output is about 200 car loads a day.

NEW GRAMMAR SCHOOL AT HEATH, NEAR HALIFAX.

THE new school buildings are adjacent to the site of the old school, and are designed in the Elizabethan style of architecture, a feeling having been expressed by some of the governors for the style of architecture prevalent in the district when the old building was erected. It having been thought judicious that some relic of the old school should be perpetuated, the "apple and pear" window is placed in the north gable of the covered drill shed, and a replica of the same window introduced into the center gable of the new building.

The plan of the school building is somewhat in the form of the letter E, the long side of which is toward Free School Lane, and set back 50 feet from the road. The center arm is formed by the assembly hall, which is placed longitudinally.

On the ground floor a corridor 8 feet wide runs the whole length of the building, and from it, to the right of the entrance hall, access is obtained to the following rooms: Cloak-room, with ingress and egress doors, lavatory, library, 18 feet by 12 feet 6 inches, and two class-rooms, each 20 feet by 18 feet. To the left of the hall there are four rooms, one being the master's room, 18 feet by 14 feet, and the other class-rooms, each 20 feet by 18 feet. Opening out of the vestibule is the porter's room, while directly opposite the entrance is the assembly-room, 50 feet by 30 feet. This, the principal department in the building, has a queen post open-timbered roof, ornamental with the characteristics of the style. In addition to the main entrance doors, this room has two side doors for the use of the masters.

The first floor is reached from the entrance hall by an open stone staircase, with oak balustrade, newels, etc., and together with the vestibule doors, arching, etc., forms a characteristic feature of the interior of the building. The main staircase is lighted from the recessed portion shown in the front view, which, while fully answering the desired end, assists in breaking up what would otherwise be a long, and perhaps monotonous frontage.

The rooms on the first floor are disposed somewhat similarly to those on the ground floor, and comprise a museum 28 feet by 18 feet, science room 27 feet by 20 feet, laboratory 20 feet by 18 feet, and private laboratory (for the use of the instructor in science) 18 feet by 12 feet. These rooms are *en suite*. To the left of the staircase there is a class-room 20 feet by 18 feet, then the school of art department, consisting of three rooms somewhat similar to the science rooms.

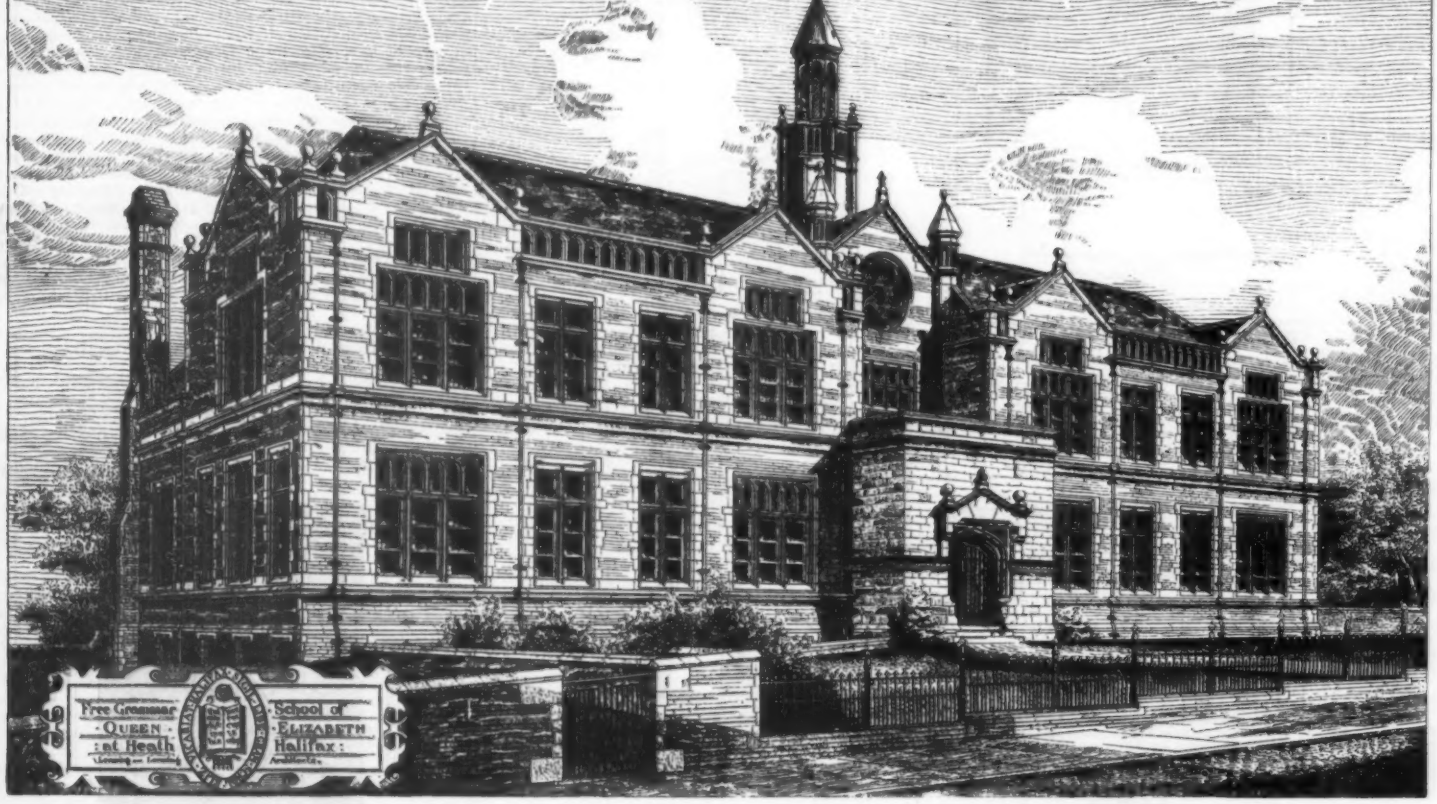
In the sub-ground floor is located the dining-room, 35 feet by 18 feet, easily accessible from the entrance hall. A cooking kitchen, china closet, lavatory, etc., are connected with the dining-room, while to the back are situated the apartments of the caretaker.

To the southwest of the school building are situated the covered drill ground (50 feet by 30 feet) and the gymnasium (50 feet by 24 feet), the latter having attached to it two small rooms, also a gallery for visitors with access from the covered drill ground.

The warming and ventilation to the school building are upon the most approved methods. The rooms, etc., have rows of hot water pipes upon the low pressure system, which is considered the most healthful. The master's room and dining-room have fireplaces in them, in addition to being warmed by hot water pipes. The ventilation is effected by Boyle's patent outlets, and Shillito and Shorland's patent vertical pipe inlets.

The work has been executed by the following contractors, who are all local men: Masonry, by Messrs. C. Bolton and Co.; joinery, by Messrs. S. Wadsworth and Son; slating and plastering, by Mr. A. S. Blackburn; plumbing, glazing, and heating apparatus, by Mr. J. Naylor; painting, Mr. J. Binns; iron railing and gates, by Messrs. Hirst Bros.; the locks and iron-mongery were supplied by Mr. R. W. Parkin, of the Sowerby Bridge.

The architects are Messrs. Leeming and Leeming, of Northgate Chambers, Halifax, and Mr. R. F. Bryan has acted as clerk of works.—*Building and Engineering Times.*



SUGGESTIONS IN ARCHITECTURE.—QUEEN ELIZABETH GRAMMAR SCHOOL, HEATH.

[NATURE.]

ON THE AURORA BOREALIS.*

HAVING been requested by this journal to give an account of my latest researches into the nature of the aurora borealis, I must explain that my lateness in complying with this request arises from the fact that I had this winter changed my residence from Bergen, where the communication was directed, to this spot—Kautokeino, in Ultima Thule.

Since September last I have, for the sake of the aurora borealis, been residing here in North Finmarken (69° N. lat., 23° E. long.), in a quarter, therefore, where the auroræ attain their maxima, and where the phenomena, consequently, are so frequent and on such a scale that there cannot be a question of selecting and analyzing one in particular. I therefore prefer to give briefly a description of its general appearance here, its character, and occurrence.

My winter sojourn here has two objects, in view—viz. first, to frame a pendent to the observations of the auroræ made at Bossekop, 1838–39, by the French Commission du Nord ("Voyages en Scandinavie," etc.), which, by the bye, later students of the phenomenon seem to have entirely ignored; and secondly, by means of altitudinal measurements corresponding with those now being made at the Norwegian Meteorological Station at Bossekop, to procure sufficient materials for fixing the parallax of the aurora borealis. I choose the remote Kautokeino for my observatory for several reasons—viz., that this place is situated almost exactly south of Bossekop, while the distance between the two places is very nearly a degree, a distance which is exactly suited to the opinion I have formed as to the height of the aurora, viz., 150 kilometers, and also for the reason that Kautokeino possesses a very free horizon, and that its situation, very far inland, would insure favorable weather conditions.

As previously stated, observations are made simultaneously here and in Bossekop on a common prearranged plan, and measurements made in the common vertical plane by the so-called auroral theodolite, constructed by Prof. Mohn. A similar arrangement has also been effected with the Finnish Meteorological Station at Sodankylä, which is, however, situated at a great distance from this place, and in in somewhat unfavorable direction (about 45° S. E.). We shall not, of course, be able to compare notes before the spring, so I am unable at present to lay before the reader the final results; but judging from my own researches here, I feel convinced, in spite of assertions made by scientists to the contrary, that the exact height of the aurora may be ascertained by the method I advocate, and that from the observations made at these three stations we shall glean sufficient materials to solve a problem hitherto deemed an insoluble one.

Auroræ occur here, I may say without exaggeration, every night, and an evening without them would be a phenomenon as remarkable as their appearance under the equator. Unfortunately, however, unfavorable weather has during the last two months, accompanied by cloud masses unusual in these latitudes, sadly interfered with the number and completeness of my observations. Still, the magnitude of the auroræ is not the same every night. Sometimes they appear as short, faint, arc-shaped phenomena, similar to those so frequently seen in South Norway, while at others they assume an extent and grandeur which mocks every attempt at description.

In one respect my researches here have been of great moment to me, *i. e.*, with regard to understanding the various types of the auroræ, their real strike and shape, and their exterior appearance, which changes in the different altitudes above the horizon; while on account of their frequency, and the circumstance that they now appear in the north, then in the south, and at last in zenith, there is a splendid opportunity to study the modifications which one particular form of aurora is subjected to when changing its position to the observer. It appears now conclusive to me that the many forms usually described in researches may be reduced to a few, almost similar types. In most instances the aurora runs in zones, belts, in the direction of the magnetic east-west, and either as a more or less diffuse luminosity, or as thin shining bands, which I have found to be parallel with the indication of the inclination needle. But the appearance which the phenomenon assumes is entirely dependent on the relative position which the observer occupies to the same. If he is thus greatly distanced from the aurora, he will only observe, a few degrees above the horizon, a continuous arc, with streamers; but if he approaches nearer, he will notice several such arcs with clearly defined constituents and a greater vibratory motion, and if still closer, he will see the "belts" or bands mentioned by Weyprecht, far above the horizon; and if these then travel toward *his* zenith, he will distinctly see the auroral "corona." I have just stated that the main strike of the auroræ is magnetic east-west; this is, however, only stated as a general rule, particularly with those of the luminous or "glory" type, while the "belts" may, besides their slight folds, be twisted and slung in almost any direction. I have thus seen them stretch from north to south, and even form a continuous circle, which, with zenith as centrum, has engirdled the entire heavens at an elevation of about 30°. The variable position of these luminous belts is the cause of the many peculiarities and the deviations from the normal which are so *frequently* observed with the arcs, as, for instance, their unsymmetrical position in relation to the magnetic meridian, and their uneven shape, viz., that they are often bent elliptically back at the points, or even take the appearance of regular ellipses. I ought, however, to point out that the faint retrograding bend which great arcs assume near the horizon is due simply to optical causes. The study of the auroral corona here is very instructive. When a belt of streamers travels toward the magnetic zenith, the radiations seem to become shorter and shorter, caused by the circumstance that they are seen obliquely, and when the belt passes the magnetic zenith, its lower rim only is seen, which makes it appear as a bent and folded luminous belt. In this position one may observe that every individual streamer has only a very limited depth, but that the belt consists of several, sometimes of a great number, of luminous "sheets" in a parallel position to one another.

Besides this form of aurora, which thus embraces two kinds, viz., the continuous and the radiating, I know only one more of a character distinctly differing from the same. I do not thus consider the individual knots of ray-auroræ, or the streamers, as anything but incomplete belts; while the luminous gatherings I consider are merely remnants, so

* In reference to the present interesting communication from Herr Sophus Tromholt, from his station in Ultima Thule, we ought to point out that Herr Tromholt was, at the time of writing, not aware of the important discovery as regards the nature of the aurora made by Prof. Lemstrom at the Finnish station of Sodankyla during December last, and of which an account appeared in *Nature*, vol. xxvii., p. 332.

to say, of previously radiant auroræ. I may also here state that the large purple auroral clouds peculiar to this phenomenon, when observed during considerable electrical disturbances in southern climes, I have never seen at Kautokeino.

Of quite a different nature is, however, the phenomenon which I have named "coruscation." This phase of the aurora, which almost without exception belongs to the earliest hours of the morning, and after large and extended oscillations of the aurora, is developed, I believe, by the luminous clouds. But while these remain quiet, or show at least subdued oscillations, the "coruscation," as I term it, is so violent and of such a peculiar nature that I have not even yet succeeded in ascertaining whether the motion is horizontal or vertical, or whether it is the luminous clouds themselves which flood the heavens, or their merely momentary "blazing up" under the influence of some passing waves of energy. The entire heaven is sometimes for hours a bath of liquid fire by this force, which seems, by the bye, to possess the same remarkable rapidity around zenith as at lower elevations.

As regard the colors of the auroræ, I have only noticed, when the substance of light is great, and when the oscillations are very rapid, two well known forms, viz., green and red. These are, however, only seen in the arcs at their lower rim, and by the forward movement one part assumes a red, another a green tint. The red color sometimes changes into violet or ocher.

The spectroscope I have not had much opportunity of using here, but the well known auroral "line" I can always see; any others I have not observed.

With regard to the height of the aurora I have, judging from observation, come to the conclusion that it does not appear at a lower elevation here than it does in the south of Norway, while I am convinced that its plane is to be found far above that of the clouds. There has often enough been an opportunity of observing auroræ and clouds simultaneously, but never has there been the slightest indication of the auroræ having descended to the sphere of the clouds, not even under the most violent oscillations and the most intense luminosity and play of color. In fact, I have come to the conclusion that the auroræ which I have watched at Kautokeino are identical with those I have studied in southern latitudes, while their plane is at the elevation which I estimated when choosing Kautokeino as my station of observation.

I may in conclusion state that I have never myself heard the slightest approach to any auroral "noise," and this in spite of my most earnest attention to this so much disputed question. Still, if I ask the native people (Lapps) about here as to the "noise," there is not a single one who doubts its existence, while several even assert that they have heard it.

I have several times attempted to photograph the aurora borealis, but without success. Thus, even by using the most sensitive English "dry" plates, and exposing them from five to seven minutes, I have not obtained a trace of a negative. The cause of this is, I believe, the exceedingly limited substance of light possessed by the auroræ: were thus even the entire heavens flooded by the most intense auroræ, their aggregate lighting capacity would not equal that of the moon when full. I may therefore assume that photographing the aurora borealis is an impossibility.

SOPHUS TROMHOLT.

Kautokeino, Finmarken, Norway, January 28, 1883.

ELECTRIC ILLUMINATION BY REFLECTION.

D. V. PARTZ exhibited a plan of a new mode of electric lighting, at the French Electric Exposition. The light was placed in chambers underneath the street, and reflected through hollow cylinders, enameled on the inside, so as to produce an inverted cone of rays, which strike a reflector placed at a height of 40 or 50 meters above the street. Among the advantages which are claimed by the inventor are: The employment of powerful electric foci, thus avoiding the loss which results from the division of the current; the equal diffusion of the light and the avoidance of the dazzling glare; the diminution of the loss of light which results from the employment of translucent globes; the readiness of access for regulation and surveillance; and the illumination of thick mists, which can be penetrated with difficulty by other methods.—*La Lumière Electrique.*

PERFECT INTERFERENCE OF SOUND BY TELEPHONE.

SUPPOSE we have two telephones having the poles of their magnets similarly placed, and so connected with a circuit that a current will traverse their coils in the same direction. It is evident that any electric current passing will cause a simultaneous movement in the same direction in the diaphragms of both telephones. Now, if we conceive the current reversed in one of the telephones, the motions will have opposite signs. It follows, then, that the currents due to the vibration of the diaphragm of a third telephones in the circuit will produce in the two telephones vibrations of *opposite phases;* the sounds produced, therefore, will differ by a half wave length. The same current which in one telephone produces a condensation will in the other produce a rarefaction.

The experiment, as successfully tried in the physical laboratory of Dartmouth College by Professor Emerson and myself, was arranged as follows: the mouths of two similar telephones were placed before the extremities of a Y-shaped tube, and the sound from both telephones conducted to the ear by rubber tubing. A reversing switch was placed in the circuit, by means of which the direction of the current in one of the telephones could be changed; in this way could be produced at will coincidence or interference of sound. Each branch of the Y-tube was of rubber, so that either arm could be closed by pinching. Organ pipes of various lengths were sounded near a telephone in a neighboring building. It was found that, when arranged for interference, the pinching of either of the branch pipes produced a very decided increase in the intensity of the sound; when reversed, an equally decided decrease. The inequality in the intensity of the sounds due to the two telephones was found to be the chief difficulty in producing complete interference; but by partly closing one branch, so as to weaken the stronger sound, the effect was much improved. In several trials the interference was complete, no sound whatever being audible. The rapid reversal by the switch gave a sharp contrast between the strengthening and the weakening effect.

This method of demonstrating the phenomenon of interference has obviously the advantage of applicability to sounds of any pitch. With singing, the interference was very satisfactory, especially with the lower notes; in conversation, however, the sound is not so much weakened, but the quality is perceptibly changed. The vowels seemed to suffer much more than the consonants.—*C. S. Cook, in Science.*

A NEW TELEPHONE RECEIVER.

THE monopoly of telephone business acquired by the United Telephone Company (albeit at a very heavy cost for patents) has had that effect upon the commercial and scientific progress of telephony which usually attends such monopolies. A company with a huge capital finds, as a rule, little difficulty in overcoming its weak competitors, and as often as not it has the option of either buying or fighting them out of the market. Then, having the business in its own hands, it can charge its own price, and, generally speaking, conduct matters as it pleases. There is also to be observed a reluctance to adopt new forms of apparatus or machinery, preferring to progress the saving which results

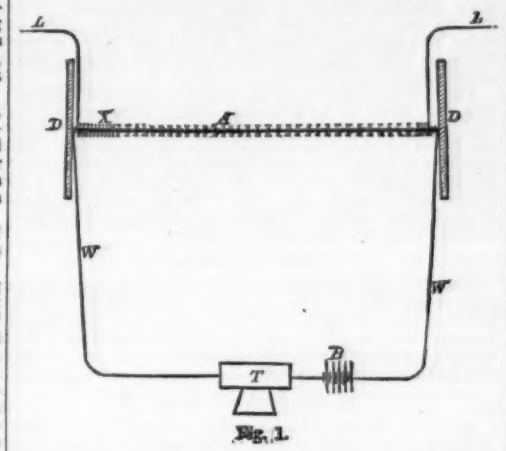


Fig. 1.

from using up older and less perfect forms. One other consequence is that inventors, or would-be inventors, are oftener than otherwise discouraged, and so improvements which might possibly have proved to be great boons to the general body are lost, buried—may be for ages—in dense oblivion. This has, we fear, been our experience in matters telephonic. We have now, however, to chronicle the introduction of an instrument which, while it possesses the advantages of a Bell telephone, differs from it very materially, both in construction and principle, and threatens, therefore, if properly managed, to become a successful competitor of the older instrument. Even were it to do no more than bring down the price charged for the existing types, it will have accomplished a most valuable task.

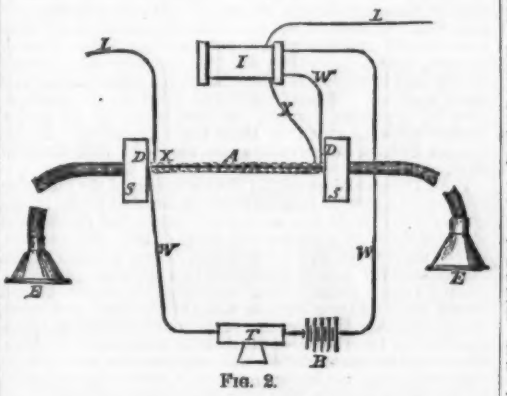


FIG. 2.

The general construction of this new telephone receiver may be gathered from the accompanying diagrams, of which Fig. 1 represents the more essential parts of the instrument, with its connections. The instrument consists of a thin wire, A, of iron, steel, or other magnetic metal attached to two disks, DD, which may be of thin wood, metal, or other more or less sonorous material; on the wire, A, is wound in the first place an insulated conducting wire, W, completing the circuit of a local battery, B, in which circuit may be introduced any known telephonic transmitting instrument, T; also on the wire, A, is wound in the second place an insulated wire, X, forming part of the line circuit, LL', communicating with a distant station. When electrical impulses are set up in the line, LL', at the distant

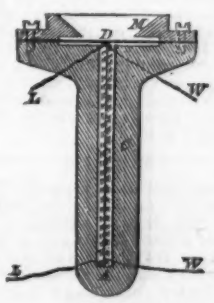


FIG. 3.

station by a telephonic transmitter, sounds corresponding with those that caused the impulses are emitted by the instrument illustrated.

The principle involved here is easily understood. It is well known that when an iron wire or rod is magnetized, it suffers a slight increase in length, accompanied by a compensating decrease in its lateral dimensions or cross section. On the cessation of the current (or the removal of the inducing magnet) the iron returns to its latent magnetic condition, and a decrease in length results. This molecular effect is distinctly audible under favorable circumstances. Messrs. Alabaster, Gatehouse and Kempe take advantage of this fact in the construction of their receiver. The current from the local battery, B, is continuous, and its effect upon the iron wire is, therefore, to make it practically a permanent magnet. When the current arrives from the distant station along the wire, LL', it in passing through the fine wire coil, X, induces a current in the thick wire coil, W, connected with the battery. The direction of the current induced in W varies, of course, with the current in the coil, X, and, accordingly, an increase or decrease in the strength of the battery current flowing through the coil, W, is produced, and the iron wire, A, is subjected to proportionately varying degrees of magnetization. The minute contractions and elongations so produced in A necessarily cause corresponding vibrations in the attached wooden diaphragms, DD, which perform in this way the function of sounding-boards to A.

The instrument may also be connected, as shown by Fig. 2, where the two disks, DD, form the ends of sound boxes, SS, having flexible tubes leading from them to funnel mouths, EE, that can be held to both ears. The wire, W, may also include in its circuit the primary coil of an induction coil, I, the other wire, X, including in its circuit the secondary coil of I. The gain effected by using the induction coil is to increase the effect upon the local battery current.

Fig. 3 shows a convenient form in which the instrument may be made. The iron wire, A, is, in this instance, inclosed in a wooden casing, C, to which one end of the wire may, or may not, be attached, the other end being attached to the single disk, D, which is clamped to the casing by an ear piece, M. This form is very light, its total weight being no more than four ounces.

As regards the efficiency of the instrument, we may say that it reproduces the sounds with remarkable clearness, even in this, its crudest form; and when the transmitter (which we are not yet at liberty to describe), as well as a further improved form of receiver, are placed before the public, we imagine that the result will fully indorse our sanguine anticipations.

It is as well, perhaps, to mention that the inventors of the receiver we have described make no general claim to the use of an iron or steel wire coiled with a conducting wire for producing sounds under the influence of electric currents, but claim—

"The construction of a telephonic receiving instrument consisting of a magnetic wire attached to a sonorous disk, or plate, and wound with a primary coil connected to a local battery, and with a secondary coil connected to the telephonic line wire, as described.—*Knowledge.*

ASBESTOS FILTERS.

By P. CASAMAJOR.

AN extensive dealer in wares used by chemists lately informed me that he had many inquiries concerning asbestos for filtering liquids in chemical analysis. Some chemists complain that they cannot get clear solutions though asbestos, while others, who obtain clear solutions, find that their liquids filter altogether too slowly.

Allow me to recall that the method of making asbestos filters, by pouring a thin paste of this material over a perforated platinum disk, was first proposed by me in 1875, but I neglected to give directions concerning the preparation of asbestos, to make it fit for filtering liquids in chemical analysis. It now appears, however, that such directions would be found useful, and I propose to repair the omission and give the necessary details.

The kind of asbestos to use is a matter of some importance. I have tried three kinds, which are sold by dealers in New York, as the *Canadian*, the *Italian*, and the *Australian*. This last is less flexible than the other two, and consequently the fibers do not felt together and pack as closely on the perforated plate. Hence liquids filter more rapidly, and the Australian is, on this account, preferable to the other two kinds. I am informed that the Canadian asbestos is the most soluble in acids, but I have not verified the assertion.

Whatever may be the kind of asbestos used, the following is a process for obtaining, with little trouble, a quantity of the pulp in a fit state for filtration:

A coarse brass sieve is placed over a sheet of paper, and a handful of asbestos is rubbed pretty roughly over the sieve cloth. This breaks it up in such a way that the smaller fragments pass through the meshes, and are deposited on the paper underneath. After a while the portion which remains on the sieve cloth is collected in one bundle, and rubbed again in the same manner, and the operation is repeated until a sufficient quantity has gone through. In a few minutes enough of the material is obtained to last for months.

As to the coarseness of mesh to use, I may say that I have used No. 10 sieve (ten openings to the inch) with satisfactory results. The sieve is best placed bottom up, so as to leave plenty of room under the cloth.

The next operation is to free the sifted material from dust, and from the finest particles. This is easily accomplished by placing the asbestos, as obtained above, over another sieve of finer mesh (about No. 25 or No. 30), and stirring it while water is poured over the sieve. The first water which passes through is quite milky, but it gradually becomes clearer as the washing is continued. The washed asbestos is then put in a beaker glass, and boiled for about half an hour with strong hydrochloric acid (about 1 part of fuming HCl to 4 parts of water).

The pulp, after this treatment, is poured over a perforated platinum plate placed in a funnel,* and washed with distilled water until no acidity is shown by litmus-paper. The pulp is then taken out of the funnel and strongly heated in a platinum dish. After letting it cool sufficiently, it may be placed in a wide-mouth bottle for future use.—*Chem. News.*

OXYGEN GAS FROM POTASSIUM CHLORATE.

By A. WAGNER.

COMMERCIAL potassium chlorate yields under all circumstances oxygen gas containing chlorine. Chemically pure chlorate yields oxygen free from chlorine if the action of carbonic acid or of organic matter is excluded. Carbonic acid, with the aid of heat, decomposes pure potassium chlorate in such a manner that chlorine is liberated. Organic substances act in a similar manner, and the residue has a strongly alkaline reaction. The presence of calcium chlorate also occasions the liberation of chlorine. The manganese ore used for the preparation of oxygen gas along with potassium chlorate not unfrequently contains an appreciable quantity of organic matter.

*A perforated platinum disk, having a stout platinum wire soldered with gold in the center of the disk, can be used in an ordinary conical funnel. The wire finds its place in the stem of the funnel, and keeps the perforated plate in position. (See *Chemical News*, xlvi., p. 8.) A Gooch crucible of sufficient size may also be used for the same purpose.

GLYCERINE; ITS PREPARATION AND USES IN THE ARTS.

By DR. A. BERGHAUS.

As already mentioned, its use in medicine is now more restricted than formerly, but it has not been entirely superseded by other things, as indicated by our previous reference to its preventing the precipitation of heavy metals by alkalies and their use for dissolving digestive ferments (like pepsine). The cellular organs which contain these ferments are cut up fine, the blood washed out with water, and glycerine poured over them. Dr. Wittich, in a communication to the Berlin *Klinischer Wochenschrift*, says that the glycerine standing over the mucous membrane of the stomach possesses an energetic digestive action, if a few drops of it are put in a 0·2 per cent. solution of salt. The diastatic action of the glycerine extract is no less energetic on the pancreas, the submaxillary, and the mucous membrane of the smaller intestines, as well as the peptic action of the pancreas on fibrine. Absolute alcohol precipitates the ferment mixed with albumen and peptones, but when recovered from the filtered precipitate each exhibits its own characteristic action in water as well as in dilute sulphuric acid.

This method of preparing pepsine for therapeutical use is to be recommended for its simplicity. It is only necessary to keep a clean dissected stomach in glycerine in order to have a supply of the active pepsine always ready on hand.

FOR VACCINATION.

In regard to the action of glycerine upon vaccine lymph, R. H. Paulcke, of Leipsic, says in his "Jahresbericht" that "the compact coagulum which is quickly formed in animal lymph, and which contains most of the active constituents, often gets so hard that it is difficult to blow it out of the quill entirely, and in such cases it must be made porous with a bristle. At the station it is customary, if the lymph shows an unusual tendency to coagulate, to add one part of pure glycerine to five of vaccine to make it keep and render it possible to blow it out. If this addition is not stated on the label, there is no glycerine in it. . . . Before using, it is advantageous to moisten vaccine which has dried on the spatula with pure glycerine and water, rubbing it up with the point of the lancet to loosen it, and then rub the spatula over the wound with gentle pressure, for the blood that oozes out is not sufficient to dissolve the vaccine matter. . . . The glass plates are partially filled with liquid vaccine, and partially with solid tissues from one or two calf pustules. The total contents are carefully mixed with one drop of glycerine and pure (undistilled) water for a few minutes to a thin paste, with which at least four persons can be vaccinated at once."

FOR MICROSCOPY.

Glycerine is indispensable for making microscopic preparations, owing to its property of rendering tissues transparent, and protecting the finished preparation from drying out. It is worthy of consideration whether glycerine can be used in finishing flax and hemp yarn.

Barreswill recommends a mixture of pulverized clay and glycerine for modeling clay, as it stays plastic for an indefinite time whether hot or cold.

MODELING WAX.

In 1880 Iwan Wasiliewitsch Plantanoff, of Moscow, patented a preparation for making ornaments, busts, etc. The glycerine was mixed with glue or gelatine, and steam passed in until it dissolved, and then wax or resin was put in and melted, and some mineral color added.

PRINTERS' ROLLERS.

De la Rue was the first to propose making printers' rollers from glue and glycerine instead of glue and molasses. He recommended for this purpose to dissolve glue in glycerine, at the temperature of boiling water, and then proceed as usual. This preparation is adapted to use for flexible and elastic moulds.

GLYCERINE BLACKING.

In the last number of the *Wochenschrift des Gewerbe Vereins in Bamberg*, is a formula for glycerine blacking:

Lamp-black	1,500 or 2,000 parts.
Burned bones	250 "
Glycerine	2,500 "
Sirup (or molasses)*	2½ "

These four ingredients are intimately mixed and then 85 parts of gutta-percha are warmed in an iron or copper kettle until nearly melted, then 320 parts of olive oil are added, and when this is dissolved, 32 parts of stearine are put in. This solution is added to the previous one while still warm and well mixed, then 160 parts of gum senegal dissolved in 750 of water are added. It may be perfumed with 15 parts of oil of lavender or rosemary. It is diluted for use with three or four parts of water, and gives a beautiful polish, is entirely free from acid, and its glycerine keeps the leather soft and pliable.

As glycerine never dries, it is much used in copying ink, stamp ink, and for keeping bladders soft. Wooden vessels of all kinds, if dipped for a few minutes in glycerine, or repeatedly painted over with it, and exposed all summer, empty or full, to wind and sun remain water tight, and the freshest wood shows no signs of shrinkage. Wooden hoops saturated with glycerine were as pliable after three months' exposure to the sun and air as when fresh.

Glycerine being soluble in water and alcohol, its use is limited to vessels for holding fats, oils (kerosene, turpentine, etc.), and dry substances. As glycerine does not change, there is no danger of its imparting a bad taste or odor to substances in contact with it. On the contrary it seems to have a preservative effect on fats, as in the case of butter kept for a long time in wooden vessels saturated with glycerine. The use of glycerine is particularly advantageous for wooden-hooped vessels that have to be stored away unused for several months at a time.

IN THE ESTIMATION OF GLUCOSE.

Its property of dissolving hydrated oxide of copper in the presence of caustic soda has recently been utilized in the preparation of a substitute for Fehling's solution for the quantitative estimation of grape sugar. It is prepared by Julius Löwe as follows: 16 grammes of pure (crystallized) sulphate of copper are dissolved in 64 c. c. of water, and to this solution there is slowly added, to prevent heating, 80 c. c. of caustic soda lye, spec. grav. 1·34 (about 113 grammes), and then with frequent shaking 6 to 8 grammes of pure officinal glycerine, or until complete solution ensues, which can be readily recognized by the deep blue color of the liquid. If a soda solution of the given strength is not at hand, a definite volume of any soda solution is taken, and enough of it added to a solution of pure sulphate of copper until the hydrate is formed and the liquid has an alkaline reaction. As much more of the same soda lye is then added as was required to produce this effect. The glycerine is then added as before, until the solution is complete. If the quantity of grape sugar is to be determined from the quantity of precipitated cuprous oxide, the presence of sodium sulphate in the solution is a disadvantage, as it is difficult to wash it out of the filter. For this purpose a solution free from sodium sulphate is prepared as follows: Pure and finely pulverized sulphate of copper is dissolved in ammonia, and then caustic soda is slowly added until the solution is quite turbid and a dense light-blue hydrate of copper begins to separate. This hydrate can be easily and completely washed with cold water, and dissolves, when dried at 30° C. (86° Fahr.) or over sulphuric acid, rapidly and quickly in caustic soda solutions in the presence of glycerine.

The hydrate prepared in this way has a constant composition, and hence it can be used in making a copper solution with a known percentage of copper. Julius Löwe found the following proportions suitable for its preparation: Six grammes of copper hydrate are mixed with 6 or 8 grammes of glycerine, and 50 c. c. of distilled water, and then 40 c. c. of caustic soda solution, spec. grav. 1·34, are added, when solution follows rapidly if shaken. It is subsequently diluted to 450 c. c. as may be desired or required.

* We give this as printed in the original, but suppose it to be a typographical error and intended for 2,500 parts instead of 2·5 parts.—*Translator.*

ITS USE IN WEAVING.

Weavers use a dressing made of 5 parts of dextrine, 12 parts of glycerine, 1 part of sulphate of alumina, and 30 parts of water, to keep their yarn soft, and it is no longer necessary for them to work in damp cellars and basements, which injured the health, as they can now work in the light, dry, and well aired rooms of the upper stories of the house.

IN PLASTERS AND PILLS.

In making plasters in tablets, the apothecary casts them in paper capsules; but in some cases the paper adhered very firmly when cold. To prevent this the capsules are now rubbed with glycerine first. If pulverized gum tragacanth is triturated with 3 parts of glycerine, and the mixture allowed to stand a few hours, a tenacious adhesive mass is obtained that makes a good excipient for pills.

AS A CEMENT.

By rubbing up glycerine and litharge together Hirzel obtained a cement that hardened soon and was well adapted for vessels that hold benzole, ethereal oils, etc. Pollack recommended the same as a durable cement for iron and stone. He says that it hardens rapidly, and hence must be used quickly. According to his statements, it can be used to fasten iron on iron, to cement stones together, and to attach iron and stone together. This cement is not attacked by strong acids. Finally, the more water the litharge absorbs, the more durable the cement; dry litharge does not hold well. C. Rost further states that the cement resists both concentrated and diluted acids, also alkalies, ether, alcohol, benzole, carbon disulphide, etc. He also says this mixture can be used in preparing a foundation for steam engines and other machines. When considering what are the constituents of glycerine cement, we are struck by its action toward acids as stated in these communications. In this respect Pollack's observations do not agree with those of Rost.

Prof. Theodor Morawski at Brunn subjected the glycerine cements to a careful investigation, in the first place in the endeavor to explain this remarkable conduct of the product obtained from the glycerine and oxide of lead, and also to ascertain the real cause of its hardening. There was still a third inducement for him to undertake this problem, namely, it seemed *à priori* probable that on heating this cement the lead would enter into combination with the glycerine, and hence there was reason to expect that in the course of such an investigation our knowledge of the metallic compounds of glycerine would be extended. We will only mention here that the supposition that the hardening process was to be explained by the formation of a lead glycerine compound resembling a salt was fully confirmed.

SOLUBLE STARCH.

The action of starch toward glycerine is peculiar. If six parts of pulverized starch are triturated with 100 parts of concentrated glycerine, and the mixture heated with constant stirring, the starch granules first swell up, according to K. Zulkowsky (*Berlin Berichte*, 1880, p. 1395), and at about 130° C. (268° Fahr.) it forms a tenacious transparent paste which becomes a thin fluid at 170° C. (338° Fahr.). If heated to 190° C. (374° Fahr.), potato starch passes very quickly into a soluble modification, but wheat starch requires an hour. If the liquid is now cooled to 120° C. (248° Fahr.), and then poured into two or three times the quantity of strong alcohol, the precipitate allowed to settle, the liquid drawn off, and more alcohol added, the precipitate grows denser. It is then to be filtered through muslin and washed with alcohol until all the glycerine is removed. This starch dissolves readily in water, can be easily preserved in closed vessels, its aqueous solution is colored a beautiful blue by iodine and is therefore useful in iodometric investigations. If dried, it loses its solubility, and must therefore be closed up soon after washing. Its aqueous solution turns the plane of polarization strongly to the right, $\alpha(\gamma) = +206{\cdot}8°$.

IN DYEING.

Gros-Renaud says that warm glycerine (75° to 81° C.) dissolves large quantities of aniline violet, and that its solvent power is greater than that of alcohol, or acetic acid. If glycerine, whether diluted with water or not, is warmed to 56° or 62° C. (133° or 144° Fahr.) and gum arabic put in, the latter dissolves rapidly and the solution keeps perfect for a long time. In Turkey red dyeing it is advantageous to extract the madder with glycerine.

PERFUMES.

Glycerine has a great power of absorbing odors, and as it does not itself get rancid when pure, can be used to carry perfumes. Let us imagine that the oderiferous portions of plants, such as blossoms and leaves, are shut up in a long tin box without being crushed, and the interstices filled with glycerine, and finally, when all the air has been expelled by frequently filling up with glycerine, the box is soldered up and left for a year in a cellar; now if we open it and press out the glycerine we shall have a slightly colored liquid, which is the bearer of the most delicate perfumes. This would be of great importance to perfumers where the odors will not stand distilling. We have odors of intoxicating power like those of the jasmine and of linden flowers, but they cannot be distilled. When jasmine flowers are distilled in steam, we get a distillate with an unpleasant smell that has not the slightest resemblance to that of the jasmine. In such cases it has been customary to use pure olive oil, but this is liable to get sour; hence glycerine is far better in such cases. Musk, which is not so easily taken up by oil, imparts its odor to glycerine perfectly.

This method is very good, but has this disadvantage, that it takes so much time. Camille Vincent, of Paris, proposes to use methyl chloride for obtaining the perfume of flowers. In the first place, to remove the small quantity of the bad smelling substance which adheres to the methyl chloride, it is purified by treating it in the gaseous state with concentrated sulphuric acid. The apparatus used in extracting the perfume from flowers consists of a vessel in which the flowers are digested, of a holder for the purified liquid chloride of methyl, of a closed vessel to catch the latter when it has been impregnated with the perfume, and finally of an air pump that serves a double purpose, first to rarefy the air, secondly to force the volatilized methyl chloride into the worm, where it is condensed again by cold. The flowers are subjected to the action of the liquid methyl chloride for two minutes, and it is then run into the third vessel above mentioned. This operation is repeated several times with fresh methyl chloride. Finally, the liquid absorbed by the flowers is removed by rarefying the air in the digesting vessel, and leading it into the condensing apparatus. The last portion is driven out by a current of steam. The impregnated methyl chloride in the third vessel is volatilized by warming to about 30° C. (86° Fahr.) and reducing the pressure to half an atmosphere. The perfume is left behind mixed with fatty and waxy substances. To obtain the perfume in a perfectly pure state this mass is treated with cold alcohol. We would add, 2,200 lb. of flowers can be exhausted daily by this process.

FOR GAS METERS.

As glycerine does not freeze, even at the temperature where mercury does, and does not get rancid, it is useful for filling gas meters. Fabian made some experiments to determine the freezing point of glycerine and water, and made out the following table:

Specific gravity.	Degrees. Beck's.	Degrees. Baume's.	Per cent. by vol.	Freezing points.
1·024	4	3·5	10	— 1¼° C. + 30° F.
1·051	8	7	20	— 2° C. + 27½° F.
1·075	12	10	30	— 6¼° C. + 20¼° F.
1·105	16	14	40	—17° C. + 1½° F.
1·117	18	15½	45	—26¼° C. —15¼° F.
1·127	19	17	50	—31¼° C. —24¼° F.
1·159	23	20	60	—33¾° C. —28¾° F.
1·179	26	22	70	Did not freeze at —35° C., or —31° F.
1·204	29	25	80	
1·232	32	28	90	
1·241	33	29	94	

In our German winters the thermometer rarely sinks to —25° C. (—13° Fahr.); it is quite safe to use glycerine of 15° or 16° Baumé, or specific gravity 1·113 to 1·121, which contains about 45 per cent. of anhydrous glycerine. In most cases a glycerine of 12° to 14° Baumé offers sufficient security, at least if the meter is at all protected. As the water gradually evaporates, it should be replaced by glycerine until finally a point is reached where the glycerine becomes so concentrated that it is no longer necessary to fill it up. Although glycerine is less mobile than water, it has no bad effect on the revolution of the drum. Bonnet, director of the gas works in Augsburg, found that 24 gas meters which been filled with glycerine, lost in four months, January and April inclusive, only 0·54 per cent. by volume. After four or five years' use in a meter, the glycerine gets so impure that Kunath recommends to purify it by putting in cast iron turnings, 10 per cent. by weight, and letting it stand from five to eight weeks, with frequent shaking for the first two weeks. A heavy sediment is formed, from which the liquid can be easily poured off.

NITROGLYCERINE AND GUN-COTTON.

The largest consumption of glycerine is in the manufacture of nitroglycerine, that most important of all explosives. While all other technical branches have been undergoing improvements, the art of making explosives has maintained until very recently a remarkable stability. The powder used in the late Franco-German war, and the explosives used in boring through Mont Cenis, had almost the same composition as those that found their first extensive use in the great wars of the fifteenth century, and the powder with which Martin Weigold made his first attempts at mining in Saxony in 1613. But that which had been for centuries at a standstill seems within a few years to have been aroused by the rapid advances made in civil and military arts. It is scarcely fifteen years since black powder was almost exclusively employed for blasting, while to-day a great portion of this domain has been wrested from it, and the indications are that at no distant day it will be supplanted by some other substitute as a projectile force, if all the innumerable attempts to find other mechanical mixtures of substances that by their combination shall form explosives are to be looked upon as unsuccessful yet.

A new era in the history of explosives began with the discovery of a series of substances which had the power of instantaneously evolving a considerable quantity of gases, without combining with other substances, and thus producing energy by explosion. In 1838 Pelouze made the discovery that cotton could be converted into an explosive substance. In 1846 Schönbein, having discovered a practical method for effecting this conversion, made public his discovery of gun-cotton. The enthusiasm with which gun-cotton was taken up soon led to experiments on a very large scale in nearly all the important states of Europe, but a series of horrifying explosions, which were attributed to the unavoidable spite of the new explosive, caused the abandonment of its manufacture almost everywhere after a few years. The upward flight of a Vienna storehouse containing 25 or 30 tons of gun-cotton in the summer of 1865 seemed like a final salute of honor over the grave of this new discovery. England alone, with her characteristic tenacity, continued the study, through a committee appointed for the purpose, of a preparation that had so many excellent qualities. Thanks to the labors of the gifted director of the chemical department at Woolwich, Prof. F. A. Abel, and his assistant, Dr. Brown, the preparation and use of gun-cotton seems to have reached a stage which secures for it incontestably the highest place among all explosives, for many war purposes.

It is an interesting fact that simultaneously with the publication of Schönbein's discovery, a young Italian named Sobrero, working in the laboratory of Pelouze, at Paris, discovered an explosive which after standing a similar fight to gun cotton is to-day the basis of the most powerful explosive and one that finds extensive use. Nitroglycerine, for that is what Sobrero named his explosive, soon after its discovery exhibited its enormous power in many accidental explosions. The substance met with no practical use, because it was exceedingly difficult to find any simple method of exploding it with certainty. Alfred Nobel, one of the most prominent chemists of the present day, was the first who succeeded in discovering a simple method of exploding any quantity of nitroglycerine. With this discovery of Nobel, which was at once the starting point and culmination of the whole development of the modern explosive art, the path was broken for a rapidly increasing use of nitroglycerine, but it was suddenly brought to a standstill by the large number of fearful accidents caused by its explosion while in transport. Most States enacted iron laws against its manufacture and transportation. It would have soon been forgotten if Alfred Nobel (1867) had not discovered a method of utilizing its enormous explosive force and removed its dangerous character. By absorbing the nitroglycerine with some pulverulent substance, he converted the liquid explosive into a solid form that was easy to transport and use. The explosive thus prepared, *i. e.*, a porous pulverulent substance saturated with liquid nitroglycerine, was called *Dynamite* by Nobel In the short space of one year its use spread so that a large number of factories, some of them equal in production to the largest government powder mills, were scarcely able to supply the demand for dynamite. The following figures, which only represent the factories under control of the discoverer, give the best idea of the rapid increase in its consumption. The number of cwts. made in these establishments was as follows:

Year.	Cwt.	Year.	Cwt.
1867	220	1872	27,000
1868	1,560	1873	41,000
1869	3,700	1874	62,400
1870	8,480	1875	80,000
1871	15,700		

In the year 1876 the total consumption of dynamite had already exceeded 5,000 tons, a quantity corresponding in power to about a quarter of a million cwt. (50,000 tons) of black gun-powder. The relation of these numbers will be better understood when we say that the total annual production of powder in the four large military countries of Europe is only about half a million cwt. The new explosives, gun-cotton and nitroglycerine compounds, are used very extensively in mining, in building streets, railroads, and harbors, demolishing wrecks, destroying forests, and breaking up unwieldly masses of iron. Dynamite is now considered an indispensable material of war in equipping the armies of nearly all large Continental countries. Gun-cotton, too, has attained the first rank for marine torpedoes.

Every hundredweight of dynamite exploded throws out on an average 20 to 30 cubic klasters of rock. Hence the quantity of rock torn loose from the earth annually now amounts to the enormous quantity of two or three million klasters. The labor costs on an average 20 marks ($5) per klaster, a saving of at least 25 per cent., or 5 marks per klaster. Hence the substitution of dynamite for blasting powder effects an annual saving of ten or fifteen million marks ($2,500,000), and we get our ores and coal that much cheaper, and make our tunnels and cuttings for so much less.

Pischof's extensive experiments have shown that it takes three times as much powder as it does nitroglycerine to move the same weight of rock, and as the cost of boring is also saved, the total saving amounts to 35 or 45 per cent. More recent experiments in Germany and America not only show an equal saving, namely, 40 per cent. in Saarbruck, 38½ per cent. at the Eureka mine, and 30 per cent. at Drittweiler, but official experiments, as at the Siegen iron mine, have shown that the effect of dynamite was six or seven times that of powder.

Of the numerous patents we will only mention a few very recent ones: J. A. Lanferey and J. L. Renard in Chartres propose to use nitrocellulose made from straw; Hellhof, of Berlin, nitrates the crude oils of coal tar; J. Engels, of Kalk, near Deutz, has described a portable arangement for making explosives with nitroglycerine in.

PRODUCTION AND PRICE OF GLYCERINE.

As the use of nitroglycerine, the best of all explosives, increases, the price of glycerine has advanced. The quantity of glycerine made in the eight glycerine making countries of Europe is as follows:

France	8,800,000	pounds.
Germany and Austria	3,300,000	"
Holland	1,980,000	"
Russia	1,980,000	"
Belgium	1,760,000	"
Italy	880,000	"
England	660,000	"
Spain	440,000	"

Gehe & Co.'s circular of last April said "that the price of glycerine had risen fifty per cent., which was due to the fact that the total production of France and Russia had been contracted for, for a whole year in advance. In 1879 the export of France amounted to 7,564,339 lb., while the imported, mostly from Belgium, about 800,000 lb. The greater part of her export, namely, 4,147,754 lb., came to the United States. Belgium received about 1,300,000 lb., part of it for other countries, and Germany about 825,000 lb.

"The consumption of glycerine is increasing in every trade, but the same cannot be said of its sources. The consumption of glycerine in pharmacy and in dyeing and printing is inappreciable in comparison with its main use for making nitroglycerine. For example, enormous quantities will be required for the Panama Canal and for tunnelling La Manche."

The amount consumed will be still further increased when they begin cutting through the Corinthian and Transindian isthmuses. In their trade report of last September the same firm said: "Within the last year glycerine has had the most important advance of all chemicals, and in all probability will play a still larger role in the next few years. Since the beginning of this year the article has risen about 100 per cent. in price, and although a certain fluctuation was noticed, still there is a tendency, and we might almost say necessity, for a still further rise, while the other products made simultaneously, the stearic and oleic acids, have sunk to such a low price that the relation between the two might almost be called uneconomical. The supply of these last named now in stock in France and Holland, the principal countries where they are made, is sufficient to last to the end of next year. The situation is just the opposite of what it used to be; the article that was formerly a worthless by-product, the glycerine, now receives almost exclusive attention. Whether this method is quite rational we will not discuss. So long as it is not feasible to make pure glycerine from the waste lyes of the soap factories, nor substitute any other liquid for it in filling gas meters [dry meters have almost entirely supplanted wet meters in this country.—ED.], whereby a large quantity of glycerine would be released from use and thrown on the market, after suitable purification, that could not fail of exerting a strong pressure on the price for a time—until something of this sort occurs, a further increase of price cannot be prevented, since the chief use of glycerine, *i. e.*, for making nitroglycerine, will bear a high price.

"Germany holds a peculiar position with respect to glycerine. With the exception of a few small factories in Alsace, which will soon be compelled to stop, none of any consequence is made in Germany. The reason is that we scarcely produce enough of the raw fats from which it is made, for other uses, and there is high import duty on them. In contrast with this France is estimated to produce four and a half million kilos., and Russia about 40,000 pud of crude glycerine. As the glycerine is free of duty, there are a large number of factories in Germany that work it up. In the gas industry the use of glycerine for meters must gradually be abandoned, and a return made to alcohol, which was formerly twice as dear as glycerine, but is now but half so dear, while it removes the water from the gas more strongly then glycerine."

Although these statements of Gehe & Co. are correct in general, we must contradict one point—that pure glycerine has not been made successfully from the spent lyes of soap makers. It has been done, as already stated, and patents have been granted for utilizing it.

FOR PRESERVING FOOD.

Important progress has been made in another direction, for glycerine is being used more and more as a preservative agent. In 1880 H. Hager published in the *Pharmaceutische Centralhalle* his recipe for a "Preservative for Meat Inspectors," consisting of 1 part of amylic alcohol, 2 parts ethylic alcohol, 4 parts glycerine, and 12 parts of water, and we must concede to it a large field as a preservative, provided chemically pure glycerine is used, for only too frequently glycerine is intentionally *adulterated*.

ADULTERATION.

Owing to the high price that it now commands, a sugar solution is often added, as it cannot be detected by taste or looks. For this purpose either a solution of uncrystallizable cane sugar (sugar house sirup) or a glucose sirup is employed. This adulteration can be detected, according to Pohl, by means of polarized light. Pure glycerine is optically inactive, while sugar solutions turn the plane of polarization either to the right or left according to the origin of the sugar. Hence it is only necessary to fill the tube of the polarizing saccharometer with the glycerine to be tested, and notice whether it causes any change in the ray of light.

TESTING GLYCERINE.

Dextrine and sugar can be detected in glycerine, says Hager, by molybdate of ammonia and nitric acid; the slightest trace of sugar gives on boiling an intensely blue color; with dextrine the test is not so delicate, as it only gives a greenish color.

C. Palm proposed to estimate the quantity of cane or grape sugar in glycerine by shaking it with chloroform, in which both kinds of sugar are insoluble, while the glycerine dissolves with the greatest ease. This proposition was, however, found to rest on an error, as was subsequently found. Glycerine is no more soluble in chloroform than the sugars. Nevertheless it is possible to separate the glycerine and sugar perfectly by means of chloroform, as it causes the sugar to separate in a solid form, while the glycerine floats on the surface of the chloroform and can be washed off by the aid of the latter. The sugar can then be weighed.

TESTS FOR GLYCERINE.

The action of glycerine upon the skin, on sores, and on wounds should be mild and gentle; but for some time past complaints have been accumulating against it, that when repeatedly rubbed on the skin it causes pustules, that it causes violent burning when applied to wounds, and may cause inflammation, even when the glycerine contains a good deal of water, or has been diluted before using. There was no reagent for distinguishing this irritating glycerine from the milder glycerine, nor could any cause for this difference in effect be discovered. Finally Hager succeeded in obtaining a good test. If equal volumes of rectified sulphuric acid, spec. grav. 1·83, and pure commercial glycerine were put in a test tube, a rise of temperature would be noticed; a slight brown color would sometimes, but not frequently, be observed. The mixture is clear, and the most that can be seen are a few air bubbles caused by shaking. Any glycerine that acts this way is mild, and suitable for use in medicine, or as a cosmetic. The irritating and useless glycerine shows a different reaction, for as soon as it is shaken with sulphuric acid there is a evolution of gas like the generation of carbonic acid in a clear solution. After the gas has all escaped and the liquid all got quiet, a fresh evolution of gas takes place whenever it is shaken. This can be repeated several times in a like manner. One kind of glycerine examined by Hager kept up a stronger evolution of gas than the others. From 100 grammes of glycerine he collected about 6 c. c. of gas, and on closer examination found it to consist of carbonic oxide and carbonic acid. After absorbing the latter with caustic potash, more than half the volume remained, so that he assumed that there was not only an oxalate, but also some formate must have been present in this irritating glycerine. The oxalic acid was detected by boiling not too small a sample of the glycerine with a solution of chloride of calcium and ammonia, when it got turbid and deposited some oxalate of lime. The formic acid was detected by mixing the glycerine with a solution of silver and letting it stand for a long time in the cold, when it reduced the silver as a black powder. Strong traces of ammonia as well as oxalic acid were found in some kinds of irritating glycerine.

All the irritating samples examined by Hager were found upon inquiry to have been purified chemically, and put on the market as chemically pure. Those of milder properties had all been purified by distillation. All the glycerine tested, of both kinds, was neutral to test paper.

This shows the necessity for using only distilled glycerine for medicinal purposes and as a cosmetic.

There is still more necessity for testing the purity of glycerine when it is to be used for preserving wine and beer. If glycerine has no nutritive value, as shown by J. Munk in the *Medicinische Centralblatt* (1880, p. 68), and is not able, like cane sugar, to prevent destruction of the albuminoids and hence cannot be called nutritious, nevertheless it is indispensable and invaluable as a preservative in beer and wine, provided that unadulterated glycerine purified by distillation is always employed.

The celebrated firm of F. A. Sarg's Son & Co., in Vienna, has justly said: "Every wine that contains an excess of tartaric acid can be sweetened by the addition of 3½ or 4½ parts of glycerine to 1,000 of wine. The glycerine must be previously mixed with a small quantity of wine and this added to the rest. Since glycerine itself is incapable of fermentation, there is no danger of changing or spoiling the wine by this addition; on the contrary, the wines keep better and soon get ripe for bottling, as the glycerine precipitates the less soluble constituents, and those which are not precipitated remain permanently dissolved, so that it is almost impossible for the wine to get turbid after it is bottled. Thick and stringy wines, when glycerine mixed with equal parts of alcohol or brandy is added to them, become as thin and limpid as at first, because it precipitates the excess of proteines to which this property is due. Glycerine is always formed by the alcoholic fermentation of sugar, and is therefore a natural constituent of wine, so that the addition of glycerine is not only permissible but rational."

What is true of wine also holds good of beers. V. Griessmayer published the following method (*Bierbrauer*, 1880) for estimating glycerine in beer, especially in the darker beers: 100 c. c. of beer is carefully evaporated on a water bath at about 75° C. (167° Fahr.) with 5 grammes of magnesium hydrate. Before the residue is perfectly dry it is triturated with 50 c. c. of absolute alcohol, filtered, and the residue washed with another 50 c. c. of alcohol. The filtrate is mixed with three and a half times its volume of absolute alcohol to precipitate the maltose and parapeptone. The filtrate is left 12 hours for the ether to evaporate. The alcoholic solution that is left is put in a tared glass capsule and evaporated on a water bath to a sirup, then dried 12 to 24 hours *in vacuo*. The residue is extracted with about 20 c. c. of absolute alcohol, the solution filtered off from the cholestearine, fat, etc., washed with 10 c. c. absolute alcohol, evaporated on a water bath, dried under an air pump, and weighed as glycerine. For light beers that have but little parapeptones, the first thick residue mixed with magnesia is extracted with absolute alcohol, filtered, evaporated to a sirup, dried under an air pump, then mixed with equal parts of absolute alcohol and ether, violently stirred with a glass rod, filtered through a very small filter that is washed with the same mixture, evaporated carefully, and the process completed under the air pump.

Very recently C. Barbsche has described a reagent for glycerine in the *D. A. Apotheker Zeitung*, saying that up to the present time it has been quite difficult to detect glycerine with certainty, and that in the presence of sugars and other organic subsiances the operation was not only difficult but very tedious. Two drops of carbolic acid, even when diluted four or five thousand times, will give a distinctly blue color with one drop of ferric chloride solution, but on the addition of 6 or 8 drops of glycerine it disappears again. If glycerine is already present in the solution, no blue color appears at all. This method leaves nothing to be desired either in simplicity, delicacy, or reliability. Alkaline liquids must be slightly acidfied before using this test.

We give these methods for detecting glycerine in beer, because, having found it in beer, we can drink the latter without running any danger of introducing into the system along with the beer some substitute that will injure us.

It will now be clear why no glycerine except that purified by distillation should be employed for improving and preserving wine and beer, and it should be obtained from manufacturers having an established reputation—good advice for all who have to use glycerine.—*Translated from a monograph published by R. Phol, Berlin*, 1882.

FLUORIC ACID.

IN the transactions of the Academy of Sciences, at Berlin, for 1768, is contained a memoir by Margraaf on fluor spar. This able chemist found that when the above mineral was distilled with sulphuric acid a volatile acid vapor was disengaged which deposited a white earth on coming in contact with water; he also remarked that the retort in which the distillation was carried on was corroded and worn into holes by the process. Three years after, Scheele published a valuable essay on the same subject, in which he proved that fluor spar consisted of lime combined with a peculiar acid, many of the properties of which were investigated by him with great success. Priestley then took up the subject, confining his attention for the most part to the action of fluoric acid in the state of gas. Since the date of these last experiments but few additions have been made to our knowledge of this acid and its various combinations.

The distinguishing property of fluoric acid is that when dry and in the state of gas it readily combines with silex, and still retains its elastic form; hence arises the peculiar and almost insurmountable difficulty of obtaining this substance in a state of purity.

Fluoric acid is procured from fluor spar; for this purpose a quantity of the mineral, being reduced to a fine powder, is to be mixed in a thick glass retort with an equal weight of concentrated sulphuric acid; upon the application of a gentle heat the sulphuric acid will combine with the calcareous base of the spar, and fluoric acid gas will at the same time be liberated, and may be received in the mecurial pneumatic apparatus in the usual way. If the heat applied to the retort is somewhat considerable, and the gas is rapidly produced, the retort will give way in the space of a minute or two, being eaten into holes by the action of the acid; if the process is conducted cautiously and at as low a temperature as possible, the retort may be made to last a considerable while longer. The gas thus produced, while confined over mercury, is perfectly colorless and transparent; it has a pungent, suffocating odor like muriatic acid, produces immediate death to animals which are immersed in it, extinguishes the flame of a candle after having previously tinged its flame of a green color, and changes certain vegetable blues to red. Its specific gravity is considerably greater than that of atmospheric air, but has not been obtained with any accuracy. If this gas is mixed with atmospheric air, a white vapor similar to but more copious than that occasioned by the muriatic acid gas in the same circumstances is the result; this appearance is partially occasioned by the combination of the acid with the moisture of the air, but principally by the deposition of silex, which takes place at the same time. The earth is in like manner deposited if the gas is received in water, and this experiment, according to the circumstances under which the acid is disengaged, exhibits a variety of singular and interesting appearances. As soon as a bubble of gas passes from the beak of the retort in-

to the water, it is immediately diminished in size from the absorption of a portion of the acid, and the whole would be taken up if the globule did not instantly become coated with the earth deposited by that part of the acid which is absorbed, for the earthy film being interposed between the gas and the water prevents any further combination till the bubble reaches the surface of the water, where it bursts. If this is performed in a jar full of water inverted over mercury, and care is taken to prevent the gas from being mixed with atmospheric air, the whole of the gas is absorbed, and the silex in proportion as it is deposited diffuses itself through the liquor, which thus at length acquires a gelatinous consistence; when in this state a greater part of the earth may be separated by putting the whole in a piece of linen and squeezing it. The acid liquid thus produced being again inverted over mercury, will absorb an additional quantity of gas, and by thus treating it three or four times, successively, a strong fuming acid liquor may be obtained, consisting principally of fluoric acid and water, but still holding in solution a portion of silex and probably also of alkali, from the decomposition of the glass of the retort. If this saturated liquor is mixed with a few drops of fluoride of silver, a slight precipitate of luna cornea takes place, and the fluoric acid is thus separated from a small portion of muriatic acid, which, when prepared in the foregoing manner, it is always found to contain. From the liquor thus purified a considerable quantity of pure fluoric acid gas may be obtained by heating it almost to ebullition, in a retort, and receiving the product in mercury. This gas appears to consist merely of fluoric acid saturated with as much water as it can hold in an elastic state, and at a moderately cool temperature seems to have no action on glass. It combines readily with water without depositing any earth, and has an astringent, acidulous taste. A candle immersed in it is extinguished without any previous change in the color of the flame; it combines with ammoniacal gas, forming a white cloud; it dissolves camphor, and is taken up in large quantity by oil of turpentine, to which it communicates an orange color and a pungent acid odor. If kept for some time in a bottle of soft glass, it acts upon it, though slightly, on which account it is a useful precaution before putting the acid in to line the bottle with a thin coating of a mixture of oil and wax.

It has been proposed by some chemists as a method of obtaining pure liquoid fluoric acid, to make use of a leaden retort and receiver, in which case the fluor spar, being previously reduced to an exceedingly fine powder, is to be mixed in the retort with an equal weight of strong sulphuric acid; the application of a gentle heat, not exceeding that of boiling water, will force into the receiver a large quantity of acid gas, where it combines to saturation with water, and thus produces liquid fluoric acid. In this process, provided the spar selected was free from quartz, there is indeed no deposition of silex, but a very notable proportion of lead is volatilized, and remains for the most part dissolved in the liquor, which, on this account, is by no means so pure as the acid produced by other methods.

Fluoric acid has not yet been decomposed, its base is, therefore, wholly unknown, and it is only from analogy that chemists suppose it to contain oxygen. A remarkable difference between the fluoric and muriatic acids is that the latter is incapable of becoming oxygenated; it will neither unite with oxygen in the state of gas nor when digested with manganese. Fluorid acid combines with the alkalies and alkaline earths, with alumina and silex, and with the metallic oxides; the metals in reguline state appear to have no affinity for dry fluoric acid, but when liquid it will dissolve iron, zinc, copper, and arsenic, hydrogen being at the same time disengaged. The order of its affinities is as follows: Lime, barytes, strontian, magnesia, potash, soda, ammonia, alumina, and silex.

The principal and almost only use to which fluoric acid has been applied is engraving on glass. It appears from Beckman that this was first practiced by an artist of Nuremberg, in the year 1670, who prepared his etching liquor by digesting together nitrous acid and finely powdered fluor spar for several hours in a warm sand bath, and then using the clear liquor as aqua fortis is employed by the copper-plate engravers. But the knowledge and application of this liquor were confined to a few German artists, till, after the discoveries of Scheele and Priestley, the fluoric acid in a purer state was employed for the same purpose by various artists in England and France, and its use afterward became general. Puymaurin found the liquid acid prepared in leaden vessels according to Scheele's process to answer well for this purpose in warm weather, but by cold its activity is so much impaired as to produce little effect even in three or four days. The gaseous acid, however, is much more efficacious, and being at the same time sufficiently manageable with proper care, merits the preference. The liquid acid is best kept in platinum vessels, upon which it exercises no corrosive action.

To engrave on plate glass, cover a piece with hard engraver's wax, and with a needle or other suitable instrument trace the intended design as in common etching, observing that every stroke passes quite through the wax to the surface of the glass, which may be ascertained by placing the glass where the light will shine through wherever the wax is removed. When the etching is completed, lay the plate with the engraved side downward on a frame in a box lined with strong sheet lead, thick tin foil, or platinum, and place on the bottom of the box a few leaden or platinum cups containing a mixture of one part of very finely pulverized fluor spar with two parts of sulphuric acid; then close the lid of the box and place it on a stove, or in any other convenient situation where it may be exposed to as high a heat as it can bear without risking the melting of the wax. Fluoric acid gas will be copiously disengaged, and in a short time (from one hour to three, according to circumstances), the plate will be found sufficiently corroded.

Other methods are employed for using the liquid fluoric acid in engraving on glass, but the above will show the principle on which it acts. Great care must be exercised in using the liquid acid, as even slight contact with it by the bare skin produces most painful and injurious effects, causing sloughing wounds which are very slow in healing, and which permanently harden and benumb the tissues affected. —*Glassware Reporter.*

THE PRODUCTS OF THE DISTILLATION OF RESIN.

THE portions of the volatile oil which passes over below 100°, if washed with soda and agitated with a strong solution of sodium bisulphite, give a crystaline deposit, formed by a combination of sodium bisulphite with various aldehydes. The portion which resists solidification is washed afresh with soda and by fractionated distillation is split up into two hydrocarbons, boiling the one at 67°–70°, and the other at 30°–40°.—*M. Ad. Renard.*

THE FLOWERS USED IN PERFUMERY.*

By W. A. WRENN.

ALLOW me to claim your indulgence to deviate slightly from the literal translation of the title of this paper, as, in addition to flowers, I have added a short description of some substances used in the manufacture of perfumes and toilet essences, either for the purpose of fixing the odor, such as ambergris, or as is required in some cases to develop the scent of certain flowers susceptible to such influences, and to give them preponderance, such as musk; or, again, to make a distinctness of their own, such as that caused by the addition of acid benzoic.

Doubtless some may think such a paper as this rather out of place among pharmaceutical and chemical data. What right has the pharmacist to engage in the compounding of perfumes—why not leave it to the coiffeur or perfumer proper? is a question which has been asked more than once, and opinions have been much diversified. I myself regard the manufacture of perfumes as a very suitable adjunct to the varied duties of the pharmacist. A sensitive nose is a very useful appendage to a chemist's physiognomy; and what can be a more crucial test than the continual intercourse with essential oils and their varied aroma to detect the numerous admixtures and sophistications which are of every day occurrence?

Again, the peculiar odor of a pharmacy, so attractive to feminine whimsicalities, is due in the main to the excess of the odor of the perfumes and essential oils over the more nauseous aroma of drugs proper; while in the matter of £ *s. d.* I think an unanimous opinion exists.

With these preliminary remarks, I will ask the attention of those who, perhaps, have passed over in recollection the interesting and varied metamorphoses between the time flowers are seen in the fields and their ultimate deposition as concentrated extracts in a toilet bottle.

A half-hour is such a limited space of time to treat such an interesting subject that I have decided to mention only those flowers, fruits, etc., which are more largely used. These are bergamot, cassie, cloves, heliotrope, jasmin, lavender, lemon, mignonnette, narcissus, orange, patchouli, pelargonium, rose, rosemary, thyme, tuberose, verbena, and violet; and briefly note ambergris, gum benzoin, musk, orris, tonquin, and vanilloes.

BERGAMOT, the essential oil obtained from the fruit of *Citrus bergamia*. It is very similar to the lemon, being golden yellow in color externally, smooth peel, and pale yellow pulp. The flowers, however, resemble those of the bitter orange. The tree *Citrus bergamia* is cultivated in Sicily, and more especially in the neigborhood of Reggio. The oil is obtained by expression, though formerly by the sponge process, from the fruit in a partly unripe state, gathered in the end of the year—November and December. New essences are now just arriving in London. The quantity of oil obtained is about 3 oz. from 100 fruits. The oil, when newly prepared, deposits an albuminoid substance, and in a month or so a white fat, called "bergaptene" or "bergamot" camphor. The green tint is due to chlorophyl, which, in a very minute quantity, may be coagulated by heat and separated by filtration, leaving the oil with a brownish tint.

The sp. gr. is about 0·880 to 0·890 in genuine samples. Hanbury gives 0·860 to 0·880; some samples gave sp. gr. 0·858 and 0·865. These were found to be adulterated, probably with turpentine and ess. of lemon, the sp. gr. of the former being as low as 0·853, and of the latter 0·832 to 0·880. The quantity of oil used in perfumery is very great, and the shipments, which are made principally from Palermo and Messina, are still on the increase.

By mixing together—

	Cubic centimeters.
Ess. bergamot	40
Spirits of wine	5
Nitric acid, sp. gr. 1·200	10
Water	45

and allowing this to stand for two months, shaking about twice a week, I obtained a fine crop of crystals (samples of which I place before you this evening). They resemble those of terpin hydrate as obtained by Mr. R. H. Parker from oil of turpentine.

Essence of bergamot is a feature in the perfume Ess. Bouquet, said to be a favorite scent of George IV.

CLOVES, the flower-buds from the evergreen *Caryophyllus aromaticus*, are so well known that I will not dwell upon them. Suffice it to say that the the oil to be used in compounding perfumes should always be the finest English drawn, and redistilled.

The crude oil, and also that known as oil of cloves' stems, can be detected by the dark color, and by giving a "paon" blue color when shaken up with three times its volume of alcoholic solution of ferric perchloride, and also a deep violet if shaken up with some reduced metallic iron. Oil of pimento might be used instead of oil of cloves, and when the latter is given in a recipe, using half oil of cloves and half pimento, a very good blend is the result. I may also mention that I find an addition of 2 per cent. of ammoniated alcohol to all the spice oils assists their volatilization.

HELIOTROPE —This well-known perfume is not often prepared from the flowers of *Heliotropium peruvianum*, or from the British variety, as one would suppose, considering the powerful odor these flowers emit; a combination of vanilla and violet being the most common substitute.

JASMIN, obtained from two species of Jasminum, *J. officinale* and *J. grandiflorum*, of the natural order of Jasminaceæ, which also supplies the Lilac (*Syringa*). The jasmin, or jessamine, is a small bush cultivated in the gardens and flower-farms of Grasse to an extent greater than any other flower, although it is the most difficult to bring to perfection, being very sensitive to changes of temperature and soil. The perfume is greatly increased by the heat of the sun, and a rainy and dull summer between the months of June and October, when the shrub flowers, is as great a disaster to the Grasse perfumer as a wet harvest is to the English farmer. The essence obtained from jasmin is used as a basis for almost every compound scent, and I always form an idea of the status of the Grasse manufacturer by the quality of his jasmin pomade and essence, for unless very carefully prepared, rancidity will quickly take place.

LAVENDER.—The natural order Labiatæ embraces several shrubs which yield very powerful volatile oils used for perfumery and flavoring, and also possessing medicinal properties in the forms of stimulants, carminatives, aromatics, etc. There are three distinct qualities of the oil: two distilled from *Lavandula vera*—Mitcham, or English, and French, principally from Les Alpes Maritimes; and that from *Lavandula spicata*—a very inferior sample, called "oil of spike." The first named—the Mitcham—at the present time commands a very high price—about as many shillings an ounce as the French oil is worth per pound—and there is every prospect of still higher prices, as, year by year, when passing through Mitcham and the adjoining villages of Wallington, Carshalton, Beddington, Waddon, Cheam, and Sutton, I have noticed fields once under lavander and mint cultivation fallen prey to the ever-increasing inroad of the speculating builder. Ten years ago there were about 350 acres of lavender; now, I believe, there are not 150 acres. It is also grown at Market Deeping and a few other places—to what extent I am not prepared to say; and I should certainly consider it would pay any speculator to direct his attention to lavender cultivation.

In England the flowers are collected in July and August, when in full bloom, and are generally distilled with the stalks as gathered, the yield being about 20 oz. for every 100 lb. Take this for granted, and an average crop of 800 lb. per acre gives 160 oz., or 10 lb. Now, suppose the increased cultivation should bring down the price of English oil to 100*s.* per lb.; this shows as a value of 50*l.* an acre, and at the rate of 50 per cent. for working expenses, stilling, rent, etc., I believe a very good return could be made. A friend of mine who some five years ago laid down about a quarter of an acre of garden ground has been fully satisfied by the amount realized by the sale of the flowers, even from so small a plantation.

The exotic oil is obtained principally from the South of France, also from Northern Italy, Sicily, and Algeria. The department of Les Alpes Maritimes produces the finest samples. The highest hill-slopes grow the nearest approach to the Mitcham.

The different qualities exported by the Grasse manufacturers are almost as numerous as the letters of the alphabet, and are distinguished by such terms as essence de lavende cultivée, lavande du Piedmont, lavande des fleurs mondées, lavande éperlé, lavende fine, lavende 1re qualite, 2me qualite, etc. In the neighborhood of Avignon I noticed some lavender growing, and was told the product was of rather inferior quality, the country being low and flat, and the soil poor. Mont Ventoux, in the same vicinity, which I traversed in my holiday tour, grows lavender of very fair quality; the altitude is about 4,000 feet above sea level.

Lavender oil is used in perfumery largely as lavender water, combined with orange and rose water, and in essences best combined with oil of cloves and benzoic acid.

Essence d'aspic is the distillate of the wild flowery plant *Lavandula spica*, and is rarely found free from adulteration, a certain quantity of prepared turpentine being added in accordance with the priced wished for. Camphor is also added to conceal this addition. Oil of spike is used in the arts and also in veterinary practice. It is not produced in Britain, the climate being too cold.

THYME.—Another plant of this natural order Labiatæ is *Thymus vulgaris*, which yields an oil used in perfumery. It is imported into this country from France; it grows also in the Western Peninsula, Lombardy, and the mountainous shores of the Adriatic and Greece, and is to be found in almost every English country garden for culinary purposes.

The distillation in Southern France is made from June to September, and the two samples of oil of thyme—red and white—are obtained from the same plant, the redistilling keeping back the coloring matter, but at the same time destroying some of the aroma. I should recommend the red oil in preference to the white, and if the color (which is often intensified by alkanet) is not desired, animal charcoal will remove it very considerably.

ROSEMARY (*Rosmarinus officinale*) may be now added as belonging to the same natural order, growing in the same localities, and under similar circumstances. It is also grown in Britain, and a small quantity of oil is distilled, but, owing to the small amount used, quite a fancy price is the rule.

The last three oils—lavande d'aspic, thyme, and rosemary—are used mostly for soap-scenting, their terebinthinate odor excluding them from the category of the more delicate perfumes.

OIL OF PATCHOULI, from the plant *Pogostemon patchouli*, which is grown in the Malayan archipelago. The oil is much used in perfumery, though, owing to circumstances, not to such an extent as formerly. Chiefly used in conjunction with otto de rose. Owing to its lasting odor a very small quantity only should be used in proportion to other ingredients.

LILY OF THE VALLEY (*Convallaria majalis*), with its pure white, bell-shaped, and delicately scented flowers, is made into essence and pomade in the Grasse manufactories, and found of great use for perfume compounding. The plant flowers in early spring, February and March being the best months for manufacturing the essence.

DAFFODIL (*Narcissus pseudonarcissus*).—Daffy down-dilly, which is found in almost every country in Europe, yields a pleasant perfume. It flowers in Grasse about April, and a little later in England. When once planted in a garden the yield will soon be found greatly in excess of the wishes of the cultivator.

ESSENCE OF LEMON.—This oil, so largely used in flavoring, etc., is also employed in perfumery. Like oil of orange, it is very uncertain in its results, owing to changes in composition consequent on keeping for any length of time. Essence of lemon is prepared in the same manner as essence of bergamot, but there is a variety termed "essence de citron zeste," which is prepared by simply puncturing the oil-vessels and allowing the oil to run out, collecting it in a receiver, and filtering. This is the best article for use in perfumery, as commercial essence of lemon is generally contaminated with very inferior distillates, or with rectified oil of turpentine, which can be detected by adding some liquor potassæ to a sample and applying heat.

OIL OF ORANGE (*Citrus vulgaris*, *Citrus aurantium*, and *Citrus bigaradia*).—From the fruits are obtained the oils of bitter and sweet orange. This perfume is not very extensively used in perfumery in the shape of oil. The water obtained from the flowers, distilled during the month of May, is imported in large quantities from the south of France.

From the flowers is also obtained an essential oil, termed "oil of neroli." The best test to ascertain its purity is to shake up a small quantity with a saturated solution of sodium bisulphite, when a permanent crimson color will be produced. The sp. gr. is 0·890, and the oil is neutral to test paper. There are two varieties of oil—essence de neroli bigaradia, and essence de neroli Portugal.

Oil of petit grain is obtained from the leaves and shoots of the above mentioned varieties, and called "essence de petit grain bigaradinet Portugal.

A mixture of oil of orange and oil of neroli, with other essences makes a very good substitute for essence of ylang ylang (a sample prepared from a formula by myself is on

* A paper read before the Chemists' Assistants' Association on January 17, 1883.

the table for your inspection). Oil of petit grain is used extensively in the manufacture of eau de Cologne.

MIGNONNETTE (*Reseda odorata*) is well known, and is much esteemed for its fragrance. Flowering in March and April, it is then prepared for use in perfumery. The cold March winds sometimes spoil the crops for the season. Several imitations are in use, and are very similar to the genuine perfume.

PELARGONIUM ROSEUM.—Rose geranium is grown for perfumery in Provence, and there is an Algerian product known as "essence de geranium d'Afric," inferior to that distilled at Grasse. This oil is used to adulterate otto de rose. Owing to the small yield—viz , 1 lb, from 1,000 lb.—it is expensive, and its characteristic odor is greatly esteemed as an addendum to the numerous items in millefleur essence. Ol. geranii E. I. is not to be confounded with pelargonium, but is obtained from several species of the genus Andropogon, and termed "ginger-grass oil."

ROSE.—First, the species *Rosa gallica*, cultivated in Southern Europa, Asia Minor, and Britain. The petals of this flower are obtained in their most perfect state for druggists' use from Mitcham. The quantity there obtained is very small, and Mitcham rose petals therefore command a high price: the same remark applies to all English-cultivated rose leaves. The dried Continental leaves are often dyed with aniline, which may be detected by macerating in spirit to which is added a few drops of ammonia. The true state of the leaves can soon be seen.

Rosa damascena.—From this is obtained the much-prized otto, or attar, of roses, which now rules at high price. When first introduced into this country it was subject to duty about 10s. per oz.; this was gradually reduced, and in 1860 was taken off altogether.

Otto of roses is imported from Bulgaria and Turkey, principally from the southern side of the Balkan range—from Kizanlik and Philippopolis—and from Smyrna (Asia Minor). It is also made in India, in the valley of the Ganges, but is never exported thence. There is also a little manufactured in France, but the quality will not bear comparison with Kizanlik. Otto is largely adulterated, as I mentioned previously, with oil of rose geranium (pelargonium), and also with oil of *Andropogon schœnanthus*, a grass grown in India, which is exported to Turkey solely for the purpose of adulterating otto.

The best tests for genuine otto are the degree at which it congeals, which should be 55° Fahr., and the appearance of the mass. The crystals, or laminæ, should be shiny, feathery, and nearly transparent. When thick and milky, and more deposited at the bottom of the bottle than at the top, spermaceti is present, and perhaps paraffin-wax, which latter is hardly so readily detected as spermaceti.

Rose water is also prepared from *Rosa damascena*, together with the essence and pomade, and imported from Grasse, Cannes, and Nismes.

TUBEROSE.—Tuberose grows in the neighborhood of Grasse, and is a bulb which requires to be replanted each spring, not being of sufficient hardiness to stand the winter. It blooms from July to October, and is not very extensively cultivated. Being a very delicate perfume, it is prepared by the cold "enfleurage process."

VIOLET (*Viola odorata*) is the most esteemed of all perfumes. It is cultivated over a large expanse of country, extending as far west as Avignon; in fact, wherever the olive is grown, being planted chiefly in olive orchards, which protect the plants from the cold winds, to which they are very susceptible. The flowers are gathered in February and March. The crop is often a failure, the result being a considerable increase in the price of the pomade and essence, in addition to bad quality.

VERBENA.—That variety which is used in perfumery is *Lippia citriodora*—lemon-grass plant—and is prepared at Travancore and Singapore, in the Straits Settlements. The oil should be redistilled before use in compounding.

AMBERGRIS.—A very useful adjunct to a toilet essence. When preparing essence of ambergris, macerate in hot water, to which is added the same quantity, by weight, of liquor potassæ as the ambergris; spirit to be added after a day or two, and maceration continued for two months before using.

MUSK.—The same remarks apply here. Always rub down the grain with sand or pumice-stone before using. The addition of one pint of any simple essence made from pomade—jasmin preferred—increases the permanence of musk. A few drops of acetic acid prevent the accumulation of ammoniacal aroma.

ORRIS.—Use only the finest Florentine; exhaust by maceration and percolation.

TONQUIN AND VANILLOES should be both selected from good samples, and care should be taken to remove the fixed oil, which may be done by adding ¼ pint of water to each gallon of the essences, when the oil will float on the surface. If not separated when compounded the essences will require a second filtration.

ACID BENZOIC.—This I have found a valuable addition to essences which are made from essential oils, and not from pomades. It is needless to add that only the English resublimed and that prepared from gum benzoin should be used.

The preparation of pomades and essences in the South of France has been so ably and minutely described in Piesse's "Art of Perfumery" that I cannot do better than advise my hearers to study the book themselves. I may add that the cold "enfleurage process," which is performed by strewing layers of flowers over thin layers of fat, the flowers being renewed daily until a good perfume is obtained, is more used than formerly, and it is the desire of manufacturers to export what are termed extra-saturated pomades in place of the well-known No. 24 strength.

METHYL CHLORIDE has been suggested as a good menstruum to exhaust flowers of their perfumes, and a manufactory on this principle was established at Cannes. I do not know if it has turned out a success. The chief difficulty at first was to have a pure methyl chloride, which was obtained by treating the ordinary methyl chloride with sulphuric acid, which absorbed the greater portion of the impurities. The extract has to be concentrated *in vacuo*—another source of difficulty—so I doubt if the old process of fat maceration can be beaten.

I subjoin a few formulæ for the manufacture of some of the best-known esences. I take for granted that the simple essences are ready at hand, and I should advise compounders—excepting those who make perfumes on a very large scale—to rely upon their wholesale friends to supply simple essences. The time, trouble, and loss in spirit which occur when making small quantities leave but little profit.

FORMULÆ.

Given essences of uniform strength, essential oils of finest quality, spirit best English grain, 56 o. p.

Ess. Bouquet.

Ex. jasmin	Oiv.
" violets	Oiv.
" rose	Oij.
" orris	Oij.
Ess. bergamot	℥v.
" citron zeste	ʒj.
" musk	℥iv.
" vanilla	ʒviij.
Otto de rose	ʒlv.
Sp. vini rect.	Oij or q. s.

Ess. Jockey Club.

Ext. jasmin	Oij.
" tuberose	Oij.
" fleur d'orange	Oiv.
" cassie	Oj.
" tonka	Oj.
Ol. santal flav. ang.	ʒij.
" neroli	ʒss.
Otto de rose, virgin	ʒj.
Sp. vini rect.	Oj or q. s.

Ess. Patchouli.

Ol. patchouli	ʒiij.
" santal flav. ang.	ʒss.
Otto de rose	ʒij.
Ext. styrax	ʒj.
" civet	ʒij.
" orris	Oss.
" jasmin	Oj.
Acid benzoic	ʒj.
Sp. vini rect.	Oviij.

Ess. Rondeletia.

Ext. orris	Oss.
" jasmin	Oss.
" musk	℥iv.
Ol. lavand ang.	ʒij.
" bergamot	ʒss.
" cloves	ʒj.
" cedrat	ʒss.
Otto de rose	ʒij.
Sp. vini rect.	Oiv.

Ess. Millefleurs.

Ext. jasmin	Oij.
" rose	Oj.
" tuberose	Oj.
" fleur d'orange	Oj.
" cassie	Oj.
" orris	Oj.
" vanilla	Oss.
" acacia flowers	Oss.
" musk	℥iv.
Ol. rose geranii	ʒj.
" bergamot	ʒj.
" lavand	ʒss.
" neroli	℥xx.
" thyme rouge	℥xx.
Sp. vini rect.	Oij or q. s.

Ess. Frangipanni.

Ext. orris	Oiv.
" jasmin	Oij.
" tuberose	Oij.
" vanilla	Oj.
" styrax	Oss.
" benzoin	Oss.
Ol. patchouli	ʒj.
" lavand ang.	ʒss.
" santal flav.	ʒss.
" red cedar wood	ʒss.
" pimento	℥xx.
" verbena	℥xx.
" neroli	℥xx.
" cinnamon ver.	℥xx.
Sp. vini rect.	Oj or q. s.

Ess. White Rose.

Ext. tuberose	Oij.
" rose	Oiv.
" jasmin	Oj.
" violet	Oj.
" orris	Oj.
Otte de rose, virgin	ʒij.
Ext. musk	ʒvj.
Acid benzoic	ʒj.
Sp. vini rect.	Oj or q. s.

In conclusion, let me say I found much information in Hanbury's "Pharmacographia," and I myself engaged in a holiday ramble in the Riviera, from Genoa westward as far as Marseilles, then inland through Avignon, a detour being made to Mont Ventoux. The whole distance, even back to Paris, was performed on a bicycle, and the useful and interesting information I received from numerous flower-growers and manufacturers, who I found very ready to give every information, added very much to the enjoyment of my holiday, an example of spending one I should recommend to many athletic pharmacists, feeling sure the labor will not have been in vain.

THE CURABILITY OF TYPHOID FEVER IN THE PRODROMAL STAGE.

AT a recent meeting of the Academy of Medicine of Paris (*Bulletin de l'Academie*, January 14, 1883) Dr. Jules Guérin maintained the existence of mild and abortive forms of typhoid fever. The modified typhoid presents symptoms similar to those of the prodromal stage of the disease as usually described, yet is not to be confounded with the prodromal stage. In each case the symptoms observed are the first manifestations of the specific poison. The difference, however, lies in this, that in the one the disease is arrested at this stage, owing to an insufficient dose of the virus; in the other the symptoms are due to the first weak efforts of a large dose, and will increase in severity unless the virus be destroyed.

The author thought that the action of the fever-poison might be compared to the action of such a poison, *e.g.*, as arsenic. When a dose of arsenic was taken, it produced, first, by virtue of its presence in the stomach, a certain local action; but presently, if it was not expelled or neutralized, it became absorbed and gave rise to a general action. So the poison of typhoid fever, when it entered the body, produced a primary local action, and then, becoming absorbed, gave rise to the characteristic train of general symptoms. The poison might be introduced primarily into the lungs though the respiratory passages, into the nervous system by absorption through the skin, or directly into the intestinal tract; and before it became absorbed into the general system it produced in these organs a certain local action, giving rise to symptoms which were truly prodromal. The prodromal symptoms would thus indicate the local action of the fever-poison before its absorption. Guerin further claimed that it was possible in this prodromal stage to eliminate the poison and thus cut short the disease. His plan of treatment was based upon this belief, and consisted in the administration of purgatives or emetics, according as the intestinal or gastric symptoms predominated, at the very earliest possible moment. He then gave charcoal, and continued the administration of evacuants and disinfectant on alternate days until the patient was cured. Dr. Guérin made the rather broad assertion that, during several years in which he had pursued this plan, he had never had a case terminate fatally.

The author's reasonings seem plausible enough; nevertheless, when he asserts the invariable curability of typhoid in its prodromal stage there is room for doubting the accuracy of his diagnostic powers. We have elsewhere heard the question put whether quinine might not avert impending typhoid. But in that instance also, although there seemed abundant evidence to justify an affirmative answer, the question was rightly considered to be still an open one. And so, while Guérin's claims certainly deserve to be noticed, we do not feel disposed to accept them as unquestionable proof of the curability of typhoid fever in the prodromal stage.—*Medical Record.*

[Continued from SUPPLEMENT No. 379, page 6063.]

MALARIA.

By JAMES H. SALISBURY, A.M., M.D.

PRIZE ESSAY OF THE ALBANY MEDICAL COLLEGE ALUMNI ASSOCIATION, FEB., 1882.

III

LOCAL SYMPTOMS.

To trace more carefully the symptoms of the local fever produced in the mouth, fauces, throat and air passages by inhaling the emanations from the incrustations of the rich, freshly exposed soil of bogs and humid grounds, on September 2, 1863, I visited the bog above referred to, and spent some time in wandering over its surface, examining the incrustation, and in collecting samples for further microscopical examinations. In less than ten minutes after my arrival on the bog, I began to feel a dry, feverish, constricted feeling in the mouth, fauces, and throat. This feeling increased till the fauces and throat became very unpleasantly parched and feverish. The opposite walls in swallowing adhered together, and the normal mucous secretions were entirely checked. There was a constant desire to swallow and hawk and spit without being able to raise much of anything, or to relieve in the least the dry, feverish, constricted sensation. This feeling soon extended downward to the bronchial and pulmonary surfaces, which became dry, feverish, and constricted, with a heavy, congestive feeling and dull pain. These peculiar symptons lasted about two hours before they had entirely disappeared. The malarious matters inhaled appeared to be poisonous to the surfaces with which they came in contact, and there seemed to be an effort on the part of the exposed mucous surfaces to close up their absorbent and secreting organs until this poisonous matter could be dislodged by the swallowing and hawking and spitting which they excited.

On the morning of the 3d of September, I again visited the bog to obtain more specimens for examination, and to study still further the symptoms produced by inhaling the malarious matters of ague bogs. I remained walking over the surface for about one-half hour. The same train of symptoms manifested themselves that I experienced on the previous day; being quite as severe, and lasting quite as long.

On the evening of the third, just at dusk, I again visited the bog to suspend plates of glass. I remained only from ten to fifteen minutes. I had scarcely left the ground when the dry, constricted, feverish feeling of the air passages began, and I experienced the same train of symptoms as on previous occasions. Between this and the last of October, I daily visited this and other like bogs, always with the same result.

On September 18th, Dr. Effinger, at my request, accompanied me over the bogs with the view of determining whether he would be affected with the same train of symptoms as myself. In a very few minutes after our arrival the symptoms began in his case, as my own; and he described them precisely as they have been already stated.

On September 20th, Dr. Boestler walked over the bog with me, and experienced the same symptoms. He remarked that he had often experienced the same or like sensations before without knowing the cause. He also stated that mouldy straw and hay had frequently excited like symptoms in his case.

Numerous other persons who visited ague bogs with me, and grounds where the palmellæ were growing (of the oblong type already described), were invariably affected with the same train of symptoms.

The only constant foreign bodies found in the expectoration of those affected with above local symptoms, excited by walking over ague bogs, and those exposed to damp, heavy night air of ague districts, are those found in the peculiar plants previously mentioned, growing upon the broken soil of low, rich grounds. It is hence inferred that the minute unicellular algæ are capable of exciting local fever in the mucous surfaces with which they come in contact; further, that there is strong presumptive evidence, from what has been previously determined, that by repeated and continuous exposure to them, they may cause general fever of an intermittent or remittent type.

On the northwest side of Lancaster, in the vicinity of the old canal mill, is another district of considerable extent, where the people are universally subject to ague. With the view of exploring for the local cause, I visited the locality September 12th. Immediately west of this locality is a wide, low, rich prairie. A few rods south of the mill, and also west of it, I found the ague plants growing luxuriantly, covering the surface of the soil recently thrown up by moles and exposed by the traveling of cattle. While collecting samples of these plants, I became affected with all the peculiar symptoms of local fever previously described.

On the north side of the town of Lancaster, immediately on the west and south side of Mt. Pleasant, is another locality where ague prevails in its worst forms, often running into fever of a continued type.

There is a low belt of ground running through this locality, along which are stagnant pools of water. Around these pools and in the rich, humid, broken soil of the vicinity, I found the ague plants growing in profusion. While gather-

ing them I experienced all the symptoms of local fever as above described.

On the Columbus road, about one mile northwest of the city of Lancaster, on the farm adjoining, on the north, the old Tallmadge farm, occurred suddenly about the middle of September a severe case of ague in a strong, healthy young man. This locality had been previously exempt from the disease. I visited the point in connection with Dr. Effinger, who was attending this patient.

About fifteen rods south of the house we discovered a new ditch about ten rods long, running through a piece of low, black, humid ground. The freshly thrown out earth and the sides of the ditch were covered with ague plants; and while procuring some for examination, I experienced all the local febrile symptoms above described. This ditch was dug about two weeks previous to the occurrence of this case of ague.

On Sept. 21st, in company with Dr. Effinger, I visited Mr. C. and family, who reside five miles northwest of Lancaster in a locality previously exempt from ague. Mr. C. was attacked with a severe form of the tertian type of intermittent fever on Sept. 1st, and his wife on Sept. 3d. The paroxysms were arrested on the fourth day of the disease with quinine, by Dr. E., their attending physician. Relapse on the fifteenth, arrested after the second paroxysm. Both Mr. C. and wife, on Sept. 21st, were much debilitated, pale, and sallow. Mr. C.'s house stands upon the edge of a low terrace elevated about twenty feet above the prairie bottom, which approaches within about fifteen rods of it on the south and southwest sides. About fifty poles southwest of the house, a small creek running through the prairie bottom empties into the canal. This creek, during rains, washes in sediment, and makes a troublesome bar across the canal.

The lessees of the canal had purchased a short time previous of Mr. C. an acre of ground at the mouth of this creek, for the purpose of excavating there a reservoir to receive the sediment of the creek. About the middle of August, workmen began the excavation. The soil removed was a rich, peaty loam, with some black and blue clay. Very soon after the work was begun the workmen began to be taken down with ague. In September, Mr. C—— was also taken down.

Sept. 21st, we found excavated soil covered with ague plants, and collected some. We contracted the local fever as above mentioned. Mr. C., who went with us, was obliged to retire. He said that he and Mrs. C. slept in a room in the southeast corner of the house on the lower floor; while their children, seven in number, from two to fourteen years of age, slept on the second floor, above them. They escaped the fever. That the fog early every morning rose about two-thirds up the first story, entering his own apartment freely through the open windows; and that it had the same odor as the soil excavated, and produced the same local febrile symptoms of the air passages. That he never had known the fog to rise as far as the windows of the story where the children slept. That the fog dissipated soon after sunrise and before his children were up. That he had lived there over forty years; had not had the ague before; that all his neighbors on the same and lower levels were now suffering from the disease. I mention this case particularly as it is of peculiar interest, showing in a striking manner a quite uniform and marked line, indicating the summit plane of invasion, above which the malarious causes do not extend.

In the east half of the city of Lancaster stands a hill containing fifty or more acres, upon the sides and summit of which the finest portion of the town is built. It rises to the height of sixty feet above the ague bog, lying near its base, and on its south and southeast sides heavy, cold, night vapors emanating from these bogs rise within about fifteen feet of its summit. The upper surface of these vapors in the morning before sunrise is seen from the surrounding hills to be a broad, level plain, limited by its contact with the adjacent hills. The line described around this hill by the upper surface of these vapors is a horizontal one, and makes distinctly the ague line. All of those living on the hill above this line are exempt; all below are subject to this disease. If any cases occur above the line, they are found to be in such persons as frequent lower levels during the evening or early morning.

During the summer of 1862, and especially during the months of August and September, intermittent fever prevailed to a remarkable extent in the town of Carroll, situated on the canal, eight miles northwest of Lancaster, Ohio. The site of the town and much of the surrounding country is low, and many boggy places occur along the canal. In these months, old and young of almost every family, including physicians, were down with the disease. I visited this locality several times, and found the ague plants growing abundantly on the partially desiccated soil, along the canal, through the town, and vicinity.

The sputa of all examined was found to be filled with the ague palmellæ.

Numerous other localities were visited when intermittent fevers prevailed, and in every instance, without a solitary exception, the ague plants were found growing in the immediate vicinity. In no instance were they found where the disease did not occur.

An interesting instance of the readiness with which the emanation from these ague plants produced the disease presented itself the last of September, one mile west of the city of Lancaster. Here, a few poles south of the pike and fifty poles west of Judge Van Tromp's residence, is a small pond that affords water to a small flouring mill. In September and August the water was low in this pond, and ague plants made their appearance in abundance on the drying, peaty mud from which the water had retired. The wind was south. There being no buildings on the north side of the pond, the disease did not appear. Near the last of September the weather became cool, the wind changed, and blew briskly from the north and northwest. Near thirty poles, a little southeast of the pond, twenty five to thirty feet above it, on the side hill, resided a strong, healthy, laboring family, who, up to now, had been entirely free from ague. The wind blew over the pond directly to this house. About the fourth day several members of the family were taken down with the disease. The wind now suddenly changed to the southeast, blowing across the pond, directly toward the toll gate, about forty rods distant, where a family resided in which were four small children. This family had been up to this time also exempt from the disease. The third or fourth day, two cases of intermittent fever appeared among the children, and soon after the father was attacked. Here is an interesting instance of the transmission of the malarious influence by the wind. These families had lived for nearly two months in the vicinity of an abundant crop of ague plants without taking the disease. The pond being small, banks abrupt, and soil around dry, no fog or night vapors emanated from the place to diffuse the poison. What malarious matters there were emanating from this point were borne north by the prevailing south wind. As soon, however, as the wind changed and blew over the pond toward the neighboring abodes, the disease in a few days appeared.

Another interesting instance came under my observation in the city of Columbus, Ohio. On a visit to this place during the last of September, 1863, I met Mr. T. H. Tallmadge, who stated to me that his children were all coming down with ague. He stated that his family had been spending a few weeks at White Sulphur Springs, and that about two weeks before they had returned home all hearty and well. In a few days after their return, one of his children came down with ague, and soon after another. This surprised him, as ague had not previously been known to occur at his residence on Broadway. Feeling satisfied that there must be some local cause, I on the following morning repaired to his house and examined his grounds. I immediately discovered a prolific crop of palmellæ just back of his house in some new, peaty soil he had drawn there a few weeks previous, to level off the surface. I directed him to sprinkle the surface of this new soil thickly over with caustic lime, after which he had no more attacks in his family.

On the rich, low limestone lands of the Maumee and Miami bottoms in Ohio, the black alluvial land of the Wabash and its tributaries in Illinois and Indiana, the fertile prairie lands of these States, and Missouri and Iowa, and on the rich, low limestone and alluvial lands of Kentucky, Tennessee, and Mississippi, ague plants develop in great luxuriance, especially during the months of July, August, and September. For the most part, wherever the soil is free from lime and the water soft, the ague palmellæ developed are mostly white, or slightly tinged with yellow or green, and the intermittents are comparatively free from congestive tendencies, and the types better marked. The eliminating organs are much less liable to become badly deranged, and the paroxysms more readily yield to the tonic influence of quinine and iron, and the disease usually is quite promptly and easily controlled unless the system be exposed to continued and constant accessions. In limestone regions, however, where the water is hard and the soil highly calcareous, there is a remarkable tendency during the months of July, August, and September for the soil to become covered with a greenish, brick colored, or plumbous hued dust or film—numerous palmelloid cells (plants), usually of a pink, brick-dust, greenish, or yellowish color, with which are confervoid filaments, frequently variously colored. The brick-dust and greenish colored cells are the most abundant.

Where the brick-dust and greenish plants prevail, the intermittents are apt to assume a congestive type; the functions of the eliminating organs (epidermic and mucous surfaces and portal and renal glands) become much deranged and partially suppressed. Oxaluria is almost constantly found, and in this state of the system quinine does but little if any good, and often in old and bad cases aggravates the paroxysms. If, however, in these severe forms the functions of the eliminating organs be restored to their normal or to increased activity by the proper diuretics, diaphoretics, expectorants, and alteratives, the paroxysms readily yield to the tonic influence of quinine and iron.

COLLEGE HILL, NASHVILLE, TENNESSEE.

This hill rises from seventy five to one hundred feet above the level of the Cumberland, which flows around its northern and eastern base. Upon its summit is an area of six to ten acres. Upon this area stands the University of Tennessee, and the residences of several of the faculty.

When the Federal forces drove the Confederates from Nashville, all the eminences in and around the city were fortified for the better defense of the place. This hill was strengthened by a ditch six feet wide and four feet deep, with the excavated earth thrown on the outside, and running around on the eastern and southern fronts, which face the adjacent country. Soon after the University buildings were appropriated for hospital purposes. This high point was supposed to be peculiarly healthy, from its elevated and airy position, overlooking most of the city and surrounding country. As soon, however, as the warm weather of May and June set in, it was found that this high ground was quite malarious, giving rise to a peculiar type of congestive intermittent that was very severe, producing in some instances death. The attendants were more subject to the disease then the inmates of the wards. This probably arose from the fact that the former often exposed themselves to the evening vapors and exhalations outside, while the latter were mostly confined to the wards. This peculiar type of intermittent became much more severe during the months of July, August, and September. The surgeon in charge

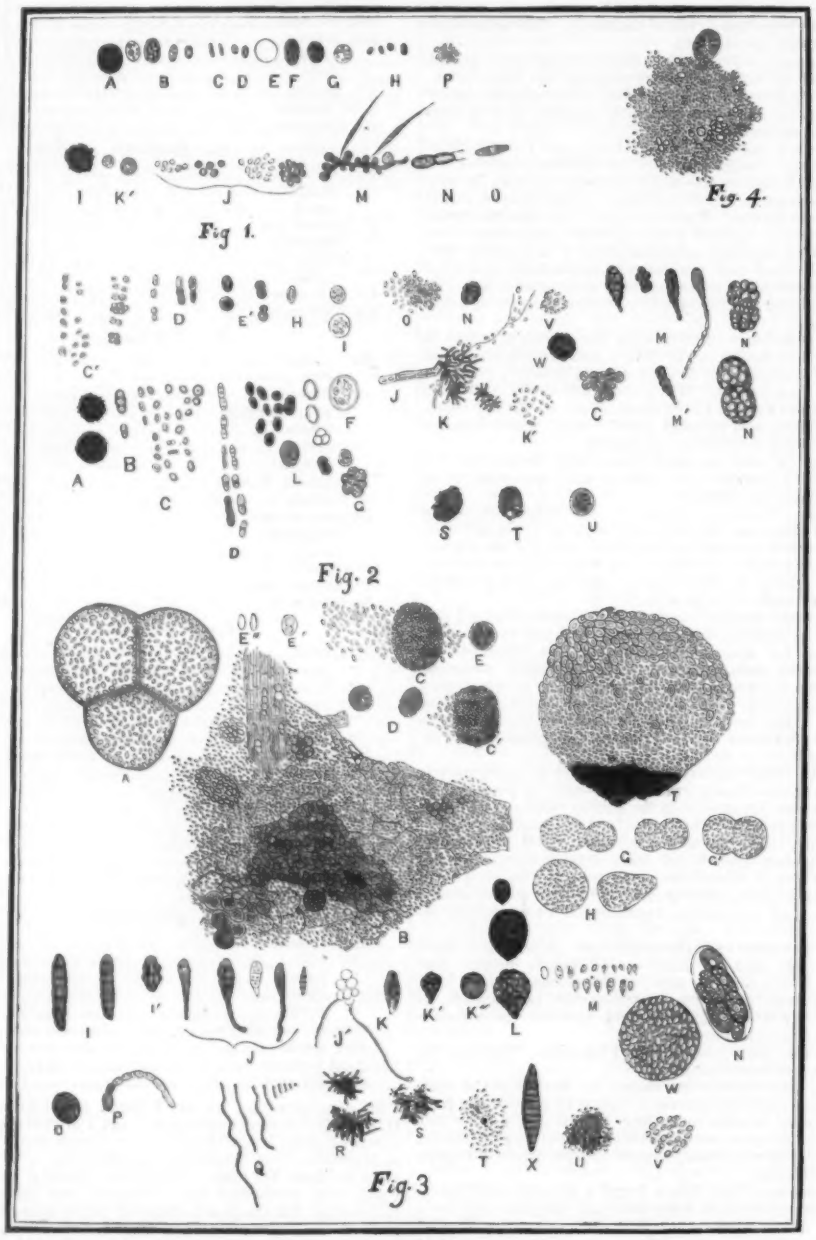


PLATE I.—Fig. 1.—A to P, Bodies elevated in the night air vapors in malarious districts and found in the water condensed under glass plates 16×22 inches square, one foot above the surface. A. B, D, F, G, H, Zoospores. C, Vibriones. E, Transparent cell (cilia left out). I, Parent cell. K, Inactive cells with nuclei. M, Algæ with two diatoms attached. N, Algoid filament. O, Diatom. P, Minute oblong cells, also constant in the expectoration of ague cases. Fig. 2.—Bodies in the night vapors of recently exposed drying soils of rich, humid, low grounds and drying peat bogs, A–W. O, N near O, K, K′, V, S, T, U, Always present in the night air and morning expectoration of persons exposed. Figs. 3 and 4.—Plants composing the incrustations of ague districts and producing the cells, spores, and young plants of Fig. 2.

AGUE PLANTS AND THEIR ALLIES AS SEEN UNDER THE MICROSCOPE.

(Dr. Lynde) was under the impression that this malarious influence came from the low grounds to the east of the hill, which bordered the river and which were half a mile distant, and one hundred feet below. This, on careful inquiry, was found to be highly improbable, as the malarial influence was much less marked on this low ground than on College Hill.

On carefully examining the soil on the perpendicular sides of the ditch which was dug to strengthen the place, it was found covered completely with cryptogamic vegetation, forming in places a greenish and in others a brick red film on the surface. Samples of this soil were preserved in tin boxes for microscopical examination.

On my arrival at Cincinnati three days after, this vegetation was carefully examined under the microscope, and found to be composed of green confervoid filamentous algæ and the unicellular palmellæ, having mostly a pale green or a brick-dust color. This vegetation was very prolific and abundant. The palmellæ were of a different species from those met with on non-calcareous soils, and were like those that are found in all districts where intermittents are of a congestive type. The outside cell wall of the red palmellæ is not readily made out, from its high transparency and entire absence of any perceptible contents outside of the central portion. This vegetation was collected on the ninth of October, and examined on the twelfth. Occasionally the soil on the surface of the hill where it had not been disturbed was covered slightly with this same vegetation. This was noticed all through the city and surrounding country, wherever there was any indication of a malarious tendency. It was not, however, noticed in any great abundance except where the fresh soil had been thrown up to a depth below where it had been usually disturbed in cultivation.

The city of Nashville stands on a series of small, conical, limestone eminences, which rise from fifty to one hundred feet above the river. The limestone comes to the surface or nearly so. This is so much the case that the rock is perfectly bare and denuded of soil over at least one-fourth of the surface, while the balance has a covering ranging from two inches to four feet in thickness. Wherever a cellar is dug, it is sunk into the solid rock. The same may be said of all subdrains and sewers. The limestone is either massive, porous, or shaly, and is rich in fossil remains. The soil on College Hill is rather deeper than on most of the surrounding eminences; and this hill has a larger and more level summit area. The digging of this defensive ditch changed the health of the locality, so that instead of being the healthiest locality in and around Nashville, it had become decidedly the most malarious and sickly.

LOUISVILLE AND VICINITY.

On the limestone soil surrounding Louisville, Kentucky, and in Jeffersonville, opposite, like species of confervoid and unicellular algæ are developed from the soil to those found at Nashville. All the low limestone lands appeared to be more or less malarious. Those just above Jeffersonville, where was being erected the new Jeffersonville U. S. Hospital, on the Chestnut Hill plan, are very malarious, This site is on a low terrace, about seventy rods back from the river, and rising about twenty feet above the river bottom. Immediately upon the brow of this terrace is located the hospital. The grounds had several sink holes which held water, now filled up. Around the base of the terrace, springs, for nearly a mile in length, make out, forming a boggy or swampy strip of ground from ten to twenty rods wide. The south winds blew over this directly to the hospital. The soil is black, sandy muck, underlaid with stiff clay, and produces during July, August, and September abundant crops of the plants I have called ague plants. Hence the hospital is unfortunately located.

CINCINNATI AND VICINITY.

On the low grounds in and around the city and along the river and canal, the soil in August, September, and October is covered with a greenish film of cryptogamic vegetation. This is made up of confervoid and unicellular algæ in piles and aggregations massed together, developed by successive duplicated segmentation and fructification. The palmellæ are either green or red. They are represented at H, I, and K, Plate. The confervoid algæ are species of the Oscillatoriaceæ.

They are the same as found in other places, but the palmellæ are the algæ that I have invariably found in all places where I have studied the vegetation that grows in malarious districts.

Camp Dennison is located about sixteen miles from Cincinnati, on the Little Miami bottoms, twenty-five feet above the river bed on a calcareous limestone soil. The hospital inclosure contains one hundred and eighty acres of bottom land. Through it runs a shallow ravine forming a draining from the adjacent hills to the river. The northern fifth of the grounds, previous to draining them with open ditches, was damp, the water standing till evaporated. The wards on this soil were found to be unhealthy; the patients were very subject to intermittent fever. Since drainage the wards have been empty. Wherever the soil is exposed by eave drains, ditches, etc., it is, during August, September, and October, covered with green algæ, which in some places become of a black ink color. They belong to the Oscillatoriaceæ; mixed with them are numerous palmellæ, one green and the other a red species. When mature, these plants send forth minute spores, which are elevated in the night vapors.

There is also met with in calcareous malarious soil another species, which occurs in irregular patches, giving to the surface a metallic, lead colored appearance. By transmitted light they have a dirty, brownish green color. By reflected light they have a metallic, plumbous hue.

The following conspectus exhibits more systematically the plants which I have found in their natural habitat on the soil and in the night air of malarious districts, and which I have also found in the blood, sputa, urine, and sweat of persons suffering under ague.

Gemiasma.—Unicellular plants, each consisting of a thin outside wall, inclosing an inside cell filled with minute microspores, either single or aggregated. Multiply by duplicative or segmentative division, within a parent membrane, and also developed from spores. Colors red, green, yellow, plumbous, etc. There are several species which seem to act as malarial poison. The brick red, green, and plumbous plants are principally found upon rich, calcareous soils; while the greenish yellow and white varieties are found mostly on non-calcareous grounds.

Gemiasma rubra.—Color, brick red; gives the soil the appearance of having been sprinkled over with brick dust; produces intermittent of a congestive type.

Gemiasma verdans.—Color, green.

Gemiasma paludis.—Color, greenish yellow. Found mostly on non-calcareous soils.

Gemiasma plumba.—Color, plumbous by reflected, and a dirty, brownish green by transmitted light.

Gemiasma alba.—Color, greenish or yellowish white.

In all these species the mass of the visible dust or incrustation of the soil is usually made up of incalculable multitudes of minute spores that have escaped from the plants beneath them. These most minute of all organisms are elevated in the night earth exhalations. Another type consists of jelly like protuberances, single or in groups, made up of a thin external membrane inclosing a highly transparent, gelatinous material filled with minute double walled spores. This type has received the generic name of Protuberans. (Ag. gave the name to this species.)

In these the double walled spores are developed in a highly transparent, jelly like frond, surrounded by a delicate membrane. These are various shades of green, yellow, brown, and perhaps other colors.

Another type of plants seems to multiply by the extending laterally of a thin lamina or gelatinous layer, which, like the protuberant variety, consists of an outside parent membrane, within which is a gelatinous matter, filled with a multitude of minute double walled spores, which escape in vast numbers as the lamina dries. This type has received the generic name Lamella. All these genera have spores of a like structure. They are more or less oval or oblong, and have double walls.

EXPERIMENTS CONNECTED WITH THE PRODUCTION OF INTERMITTENT FEVER, BY INHALING THE NIGHT EXHALATIONS FROM SMALL BOXES OF DEVELOPING AGUE PLANTS.

To obtain more positive evidence of the intimate relation between the cause of intermittent fever and the algæ grown on dry, humid soils, I filled six tin Seidlitz powder boxes with the surface earth from a decidedly malarious, drying prairie bog, which was covered with the palmellæ above described. Cakes of the surface soil were cut out the size and depth of the boxes, and fitted carefully in, without disturbing more than possible the surface vegetation. The covers were then placed on, and the boxes transported to a high, hilly country, five miles distant from any malarious locality, and where a case of ague had never been known to occur.

It was over three hundred feet above the stream levels, was dry, sandy, and rocky. I here placed the six boxes of ague plants on the sill of an open second story window, opening into the sleeping apartment of two young men. I removed the covers and gave particular directions that the boxes should not be disturbed, and the windows left up. Suspending a plate of glass over the boxes, on the fourth day I found the under surface completely covered with the palmellæ (Gemiasmas); on other plates suspended in the room at the same time, I found numerous Gemiasmas adhering to the chloride of calcium solution.

On the twelfth day, one of the young men had a well marked paroxysm of ague, and on the fourteenth the other was taken down with the disease. They both began to feel unnatural and dull about the sixth day. All three stages of the paroxysms were well marked. The type in both was tertian. It was readily controlled with quinine and iron and acetate of potash, with warm diaphoretic drinks on retiring. Four members of the family slept on the lower floor of the house, but none of them were affected.

The experiment was repeated at another point in the same neighborhood, where one young man and two boys were exposed in the same way as described in the previous cases. In this instance, the two boys were taken down with the disease, one on the tenth, and the other on the thirteenth day of exposure, while the young man escaped. On account of other duties, and the difficulty of obtaining the consent of parties for experiment, I have been unable to conduct this part of the examination further. The experiments thus far, however, are highly satisfactory, and confirmatory of the previous observations and results of this extended inquiry, on which nearly three years of almost constant labor have been bestowed.

Later, in November, 1866, I placed a large pan of the ague soil in Dr. House's office. Dr. House at that time was my assistant. It was loosely covered with a newspaper, and forgotten. In a few days the Doctor began to have pains in the back and limbs. These symptoms were followed by a well marked paroxysm of ague. As soon as this occurred, the pan of plants was removed. His wife and daughter, who had spent part of their evenings in his office, were in a few days after taken down with the same disease. Dr. E. Sterling, of Cleveland, Ohio, treated these cases, and can testify to this statement. I may state here, that this occurred after the ground had frozen up, and all danger in taking the disease outside had ceased.

[*To be continued.*]

MUSIC IN JAPAN.

MR. LUTHER MASON, who was for a long time Superintendent of Music in the Boston Public Schools, has been three years in Japan, holding the office of Director of the Imperial Conservatory of Music at Tokio. In July last he obtained a year's leave of absence, in order to visit his family in Boston, and to extend his inquiries as to elementary music teaching in the chief cities of Europe. This is the third visit of a similar kind that Mr. Mason has paid to Europe, and his observations have been very extensive. He has been specially anxious, during this last tour, to inquire into the methods of teaching the blind. In Japan, owing to the prevalence of small-pox and the want of good surgery, there is a large proportion of blind, for whom very little has yet been done. Mr. Mason spent some time at the Blind Asylum in Paris, and every moment he could spare at the Royal Academy of Music for the Blind at Norwood, which is under the management of his gifted countryman, Mr. F. T. Campbell. Mr. Mason studied school music at several points, including Berlin, Hamburg, Carlsbad, Copenhagen, Stockholm, Christiania, and Paris. Almost everywhere he heard tasteful and artistic singing, but Paris was the only place in which he was asked to test the children in sight-singing or in which anything was said on that subject. At one capital city he ventured to ask for a sight-test. The master, driven to the point, gave one, which the children completely failed to do; whereupon the master lost his temper, boxed the children's ears, and struck them with his baton. This "coda" to a sight-test was not contemplated by Mr. Mason, and he never asked for another during his travels. We put it to him bluntly whether, in every place but Paris, the singing he heard, finished as it was, was not virtually singing by ear. His reply was: "Well, I was treated so kindly in all these cities that I do not like to say anything against them; but I am afraid you are right." In Paris he was at the Normal School for Masters—corresponding to that for Mistresses which Mr. Curwen lately visited. The occasion was a special one, a commission being present, charged with deciding if the plans for teaching singing in the Paris schools should be extended to the rest of France. Mr. Mason heard some fine results, and was much pleased.

In Japan Mr. Mason's work has been most interesting. He has been judicious in his reforms, saying nothing against the Japanese music, but silently placing against it the European scale and instruments. The Japanese scale has no fourth and seventh, and the third and sixth are sung and played sharp, as if partly to fill up the gap left. There is also a great deal of portamento in both playing and singing. The flutes have large holes, and the player can raise or lower a note by his finger. Thus the whole effect is indecisive. The Japanese have no notion of harmony, except some slight idea of accompanying in fifths and fourths, and as a natural consequence they have no tonality or key. Some of their music is minor, the second and sixth of the minor scale being omitted. As to singing, this is chiefly a kind of recitative used by players, who sing about what they are going to play. There is also another kind, in which men and women join, singing in (absolute) unison.

In this sort of singing the aim of the women is to sing as low as possible, and of the men to sing as high as possible. The way the women are trained is this: An old hag will take a company of young girls out on a damp and cold night. They will sit on a bridge, or by the roadside, until they have caught cold. Then, when they are sufficiently hoarse, perhaps next day, the training begins, the younger ones imitating the croak of their preceptress. They sing violently—after the fashion recommended by the Rev. Mr. Sandlands—and it is considered a good sign if they spit blood. This process—getting hoarse and singing loudly—is repeated until the necessary depth of voice is attained; the women then can reach C on the second space of the bass clef. The men work in the opposite direction, and strain their chest registers up to G and A. The united result is not lovely.

Mr. Mason, when he got to Japan, began in the kindergarten school attended by the children of noblemen. He introduced "Bonny Doon," "Auld Lang Syne," "There is a Happy Land," and other pentatonic melodies, which, of course, the Japanese children readily sang. The fourth and seventh had afterward to be taught. The seventh gave special trouble, as there was a strong tendency to sing it half a tone flat. When it was sung rightly, then the *Do* above was often given half a tone too sharp.

The court musicians had meanwhile watched Mr. Mason's doings, and they came to him inquiring for the reason of the difference between their scale and that of Europe. They asked Mr. Mason which was the best scale. He declined to express an opinion, but advised them to get the Professor of Physics at the University (a German) to give them a lecture on the ratios and general structure of the European scale, so that they might draw their own conclusions. The lecture duly came off, and it fully satisfied the court musicians. Two military bands, under European bandmasters (a Frenchman and a Russian) were already in existence, and a full orchestra was at once established. This is under Mr. Mason's charge, and he has compiled elementary manuals for the violin, viola, 'cello, and double bass for its use. Mr. Mason does not know more than a few words of the language, and works always through interpreters.

Mr. Mason has also compiled an elementary singing manual for the primary schools, but has not encouraged its circulation, because he sees that teachers, not books, are the first requisite in Japan. If this book was circulated, it would be misused; its use is to follow, instead of preceding, trained teachers. Mr. Mason has concentrated his efforts upon the Normal School for teachers, at Tokio, and hopes, in a few years, to send large numbers of qualified teachers to all parts of the land. His method of working shows him to be a true educationist.—*The Tonic Sol-Fa Reporter (London).*

CURIOUS VEHICLES OF LOCOMOTION.

MAN, no doubt, from the very earliest period, sought some vehicle of locomotion other than that provided by his own limbs. While yet the world was young—very young—he soon discovered that it was easier to bestride some four-footed animal's back than to walk when on a long journey, and one would like to know which was the first quadruped selected. The barrow or sledge was probably the very first vehicle used for the transportation of heavy articles; it would naturally suggest itself for use on land much as the raft undoubtedly did for the water.

On a bass-relief of the Temple of Luxor at Thebes, there is the representation of a barrow precisely similar to those at present in use by the London brewers' draymen. Later, rollers suggested themselves for moving heavy bodies; on the same bass-relief a kind of box mounted on bars of wood turned up in front, exactly like the runners of a rough sledge, is shown in progress over rollers. The latter were the precursors of the wheel, which ingenious contrivance must have been invented at a very early period, as chariots were in common use by all the Oriental nations long before the date of authentic history. Who was the inventor?

Wagons, open or covered, were also known in the earliest times: among the Egyptians, Persians, and Syrians they were covered with leather or wood; among the Scythians roofed over with thatch like the top of a beehive. Something very similar to the first is shown to exist at the present day in the country carts of Java, and to the second in the Bengalese wagon. As early sculptures were more often the representations of battles than of domestic scenes, we know more of the chariot than of the cart. On the east front of the Temple of Luxor is the sculptured picture of a victory, in which one hundred men are engaged in chariots, and which was, it is believed, executed five hundred years before the epoch of Moses. At the battle of Gilgal, the Philistines are stated to have had thirty thousand chariots, and on one occasion David took four thousand of them from the enemy. Homer's heroes all fought in chariots. The early Greek examples were always shell-shaped; those of the Egyptians were square. One reads also of solid metallic chariots, brazen and bronze. Hesiod records the fact that not less than one hundred varieties of wood were used in their construction.

When once wheels and axles became familiar, the progress of carriage-building was rapid. Ericthonius, being lame, introduced a wheeled litter, or coach, for his own use into Athens, an early forerunner of the chariot or carriage. Among the Greeks and Persians much luxury was indulged in: their pleasure-carriages were built of ebony or other fine woods, covered or inlaid with ivory, gold, or silver, gilded or adorned with bass-reliefs, pictures, and statues. They were decorated with stuffs of silk, velvet, and tapestry of the richest colors, wrought with gold, silver, pearls, or precious

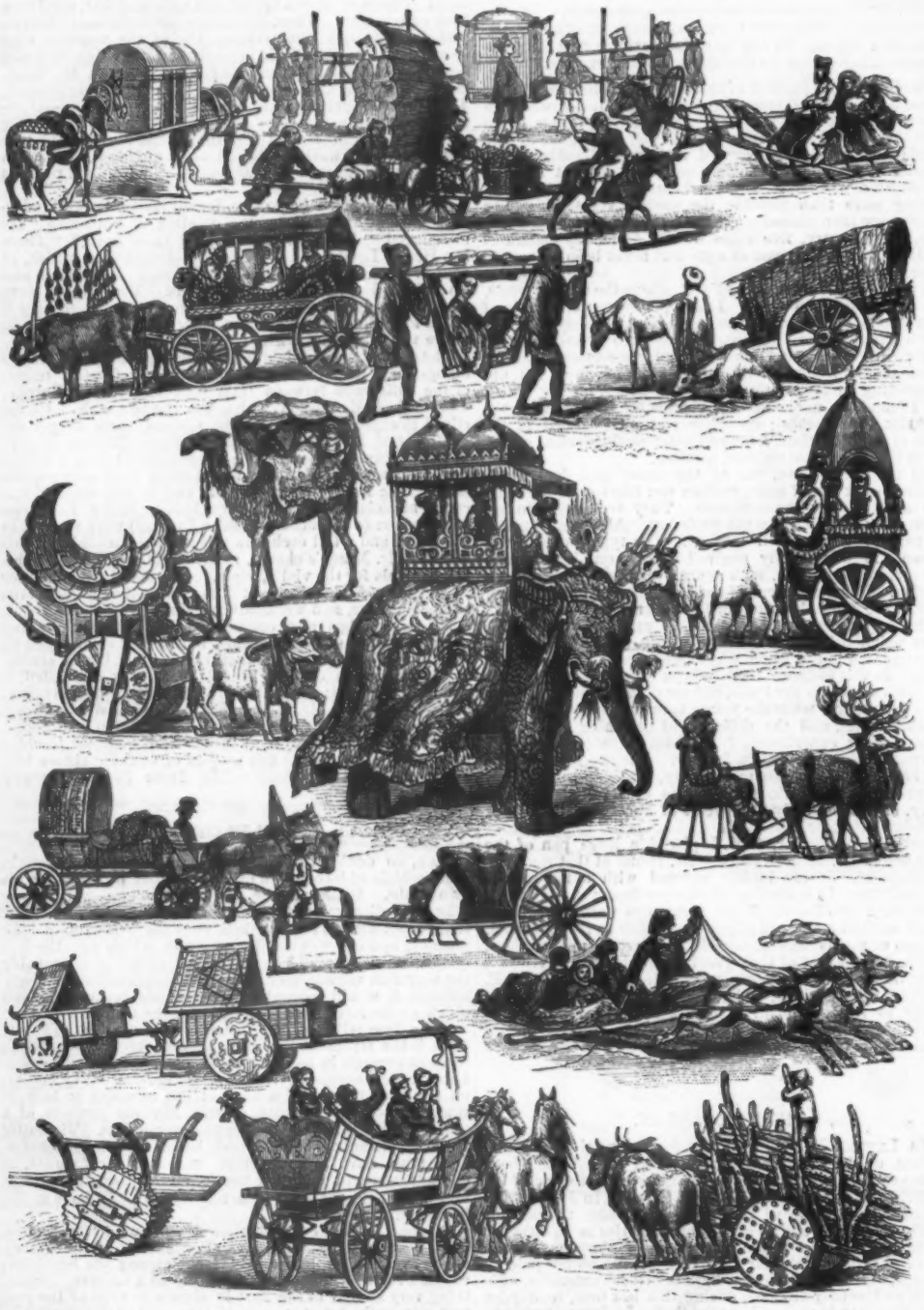
stones, while on the seats and floors were spread the softest skins, very generally dyed purple. The harness was of soft and well tanned leather, often worked with gold, while the collar or neckstrap was inlaid with shields and settings of gems. The horses' manes were interwoven with bands of threads of gold, or were drawn in locks through golden rings.

The vehicle most employed by the Greeks was the *Apene*, a light two or four-wheeled carriage, covered and surrounded with curtains, and the interior fitted with cloth, leather, or goatskins. Timoleon, then an old blind man, on the occasion of an important debate, is said to have driven into the forum and delivered his opinions from his apene. Many may think that the wickerwork and basket carriages and chaises now popular, especially in the country, are of modern invention. Not at all; the Greeks had basket carriages, which their young men were accustomed to use for racing purposes.

The *Cisium*, a kind of cabriolet with two, three, or even four horses, was the most generally used Roman vehicle. It was simple in construction and had no cover. It was the post-chaise of the Roman Empire, and in process of time, for purposes of speed, came to have very large wheels. The seats were soft-cushioned and suspended in straps, so that little irregular motion was felt. Seneca says: "You may ride long and comfortably in the cisium." The pilentum was a comfortable carriage, with half-round canopy roof supported on four thin pillars, while there were several other varieties of covered family carriages and coaches among the Romans.

To our own country and comparatively modern times may seem a great leap, but the subject is a vast one, while at periods there has been retrogression rather than progression in the history of vehicles of locomotion. The first coach used in England seems to have made its appearance in 1557, or eight years after its introduction to France. Previous to this, horsemanship was universal, and most women in any higher rank of life rode, some of them on pillions, seated sideways behind their husbands or servants. Bad roads were the main cause of the almost universal use of pack-horses for the transportation of goods. By Queen Elizabeth's reign, coaches were, under the strange name of "whirlicotes"—the origin of which is buried in obscurity—becoming familiar. Elizabeth began with two horses, and never used more than four; the Duke of Buckingham drove six, and the Duke of Northumberland, to outrival him, eight horses. We of this generation, familiar with cabs and hackney coaches, omnibuses and street-cars, are apt to forget that they are very modern luxuries indeed. Vehicles were first let for hire in Paris in 1650, and these were probably the first so employed in all Europe.

When sedan chairs—the universal vehicle of China*—were the first introduced in England, the people proclaimed their disgust by hooting and railing at the occupants, "loathing," says an old writer, "as they did, that men should be brought to as servile a condition as horses." "Coaches and sedans," quoth the waterman, "they deserve to be thrown into the Thames; and but for stopping the channel I would they were there, for I am sure where I was wont to have eight or ten fares I can scarcely get two the whole day." The writer of a tract in 1673 deprecates "the multitude of stage coaches and carriages traveling on the roads," and advises Parliament to suppress the former, "especially within fifty or sixty miles of London," while he recommends that the latter should be forbidden to travel more than thirty miles a day in summer and twenty-five in winter.—*Leisure Hour.*



CURIOUS VEHICLES OF LOCOMOTION.

* The sedan and palanquin are still the only modes of conveyance by land common in the Celestial Empire. Many years ago some exquisite specimens from the best Long Acre coach manufactories were sent out as a present to the Emperor of China, the ambassador of the expedition being Lord Macartney. To this day they remain as they were sent, standing as curiosities in one of the palaces. Some English gentlemen asked a mandarin why they were never used. The answer was that it was impossible for the Emperor to allow any man to sit above him! He strongly objected to the coachman!

NATURAL SUGARING.

LEPIDOPTERISTS have long found sugaring, *i. e.*, the besmearing of tree trunks with various more or less intoxicating sweets, one of the best means of obtaining night-flying moths, but we do not recollect of seeing any record of what may be called natural sugaring. The year 1882 has been remarkable for the excessive abundance of a yet undescribed species of Lachnus, which we have called *Lachnus platanicola*, infesting the sycamore. We have received accounts of its excessive abundance from widely different sections of the country, as far north as Michigan and as far southwest as Missouri; while on trees in the grounds of the Department of Agriculture it has prevailed to such an extent that whole trees, including leaves, branches, and trunks, were heavily blackened by the growth of the fungus (*Fumago salicina*) which developed on the saccharine exudations from the Lachnus. Hosts of sweet-loving insects, including all sorts of hymenoptera during the day and chiefly lepidoptera at night, were attracted to the trees, which even excelled those artificially sugared as collecting ground for various noctuids. The brilliant and glistening eyes of these moths, thickly settled upon all parts of the trees, gave these at night the appearance of being studded with gems, and produced an effect rarely witnessed, we imagine, by entomologists.

The comparatively sudden and excessive increase of a given species, as in this instance, over a wide extent of territory, is always remarkable and somewhat difficult to explain. We have observed that the conditions which permit such undue increase are often widely prevalent, and that species, about the life-history of which little or nothing was previously known, are often studied by observers in different parts of the country during one and the same year.

The average expanse of the winged male of *Lachnus platanicola* is 14 mm., and length of body 4·5 mm. It bears a close resemblance to *L. longistigma*, Monell, but is at once distinguished, among other differences, by its smaller size, paler wings, and paler stigma. The apterous, oviparous, or true female has an average length of 8 mm. The eggs are about 2 mm. long, elongate-ovoid, highly polished and sticky, orange brown when first laid, but changing through olive-green to dark brown and finally almost to black. They covered the branches on the under side so thickly as to attract a host of different predatory insects, which often cleared the branches with a regularity that was astonishing.—*C. V. Riley, in Amer. Naturalist.*

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TABLE OF CONTENTS.

PAGE

I. ENGINEERING AND MECHANICS.—Proposed New Lighthouse at the Mouth of the Weser.—Several figures 6065
Turbines for Small Industries.—Several figures 6056
A New Fan.—1 figure 6057
Project of a Tunnel Under the Elbe, near Hamburg.—1 figure 6057
Improved Running Gear for Cars.—2 figures 6057
Automatic Indicator for Signaling the Passage of Trains.—2 figures 6057
The Wordsworth Gas Engine 6058
New Forms for Boats 6058
Thirty-foot Hand Derrick. By T. APPLETON.—Several figures 6059

II. CHEMISTRY AND METALLURGY.—Bull's Iron and Steel Direct Process 6060
Asbestos Filters. By P. CASAMAJOR 6063
Oxygen Gas from Potassium Chlorate. By A. WAGNER 6063
Glycerine; its Preparation and Uses in the Arts. By Dr. A. BERGHAUS 6064
Fluoric Acid 6065
The Products of the Distillation of Resin 6066

III. TECHNOLOGY.—Improved Incubator.—1 figure 6058
The Flowers Used in Perfumery. By W. A. WRENN 6060

IV. BIOGRAPHY.—James Nasmyth 6060
Richard Trevithick 6061

V. ELECTRICITY, LIGHT, HEAT, ETC.—On the Aurora Borealis 6062
Electric Illumination by Reflection 6063
Perfect Interference of Sound by Telephone 6063
A New Telephone Receiver.—3 figures 6063

VI. MEDICINE AND HYGIENE.—The Curability of Typhoid Fever in the Prodromal Stage 6067
Malaria. By Dr. JAMES H. SALISBURY.—III. Local symptoms.—Ague bogs.—Transmission of malarious influence by the wind.—Intermittent fever caused by overturned earth.—Ague plants.—Experiments with small boxes of developing ague plants.—Several figures 6067

VII. ARCHITECTURE.—New Grammar School at Heath, near Halifax.—Illustration 6068

VIII. NATURAL HISTORY.—Natural Sugaring 6070

IX. MISCELLANEOUS.—Grunow's New Camera Lucida 6061
Music in Japan 6069
Curious Vehicles of Locomotion.—Numerous illustrations 6070

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